CIVIL ENGINEERING

Four-level freeway crossing in Los Angeles

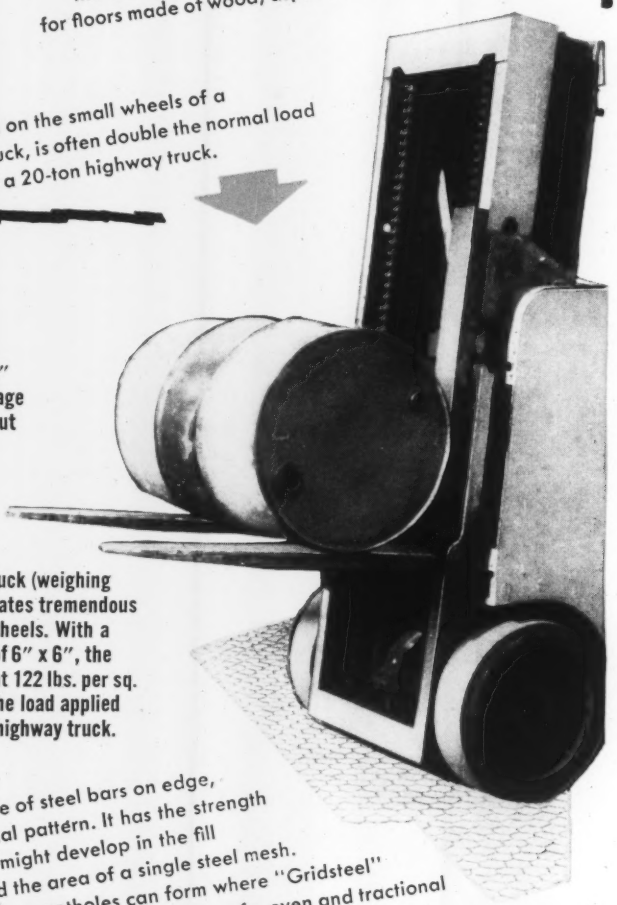
HIGHWAY PLANNING ISSUE

AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852

CAN YOUR FLOOR TAKE TODAY'S HEAVY TRAFFIC ?

The wear from heavily loaded industrial trucks and the impact from heavy objects often prove too severe for floors made of wood, asphalt or even concrete.

The concentrated load on the small wheels of a modern fork lift truck, is often double the normal load applied by the wheels of a 20-ton highway truck.



FOR EXAMPLE:

14" **16000 LBS.** 20"
H-20 TRUCK WHEEL CONTACT AREA

A 20-ton highway truck (with a wheel load of 16,000 lbs. on a 14" x 20" contact area) has an average load concentration of about 57 lbs. per square inch.

6" **4400 LBS.** 6"
LIFT TRUCK WHEEL CONTACT AREA

A 4,000 lb. capacity lift-truck (weighing 6,400 lbs. itself) concentrates tremendous loads on its small steel wheels. With a maximum wheel contact of 6" x 6", the load concentration is about 122 lbs. per sq. inch—more than double the load applied by the wheels of a 20-ton highway truck.

Irving "Gridsteel" is a floor armor made of steel bars on edge, forming an overall hexagonal pattern. It has the strength and life of steel. Any crack which might develop in the fill cannot spread beyond the area of a single steel mesh. No ruts or potholes can form where "Gridsteel" provides the floor surface which is safe, even and tractional at all times—suited to today's needs.

"A FITTING GRATING FOR EVERY PURPOSE"

IRVICO®
ESTABLISHED 1902

For complete information write for 20-page color catalog on Irving "Gridsteel".

IRVING SUBWAY GRATING CO., Inc.
ORIGINATORS OF THE GRATING INDUSTRY

Offices and Plants at:
5008 27th St., LONG ISLAND CITY 1, N. Y.
1808 10th St., OAKLAND 20, CALIFORNIA

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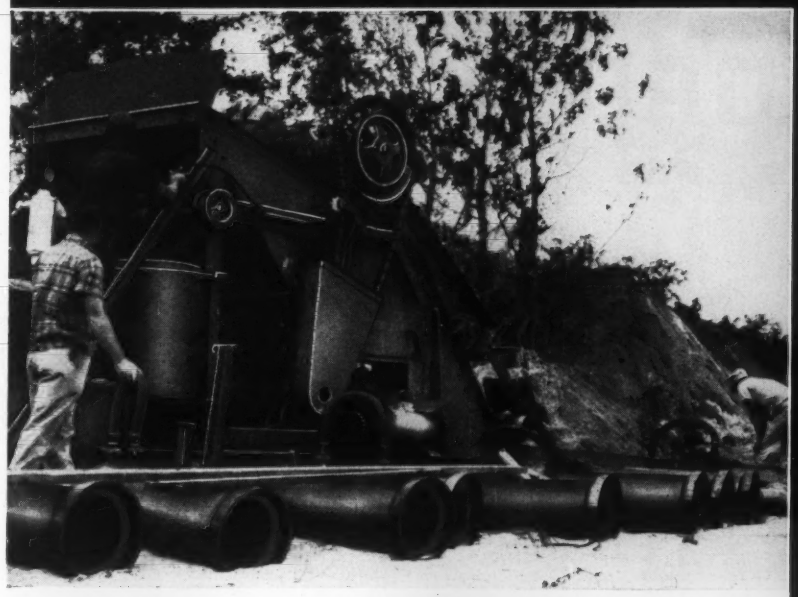
When it's bond-financed . . . don't take chances!



Specify NEVER-WEAR-OUT CLAY PIPE

SANFORD, FLORIDA, chose Vitrified Clay Pipe for this bond-financed project, where 22 miles of sanitary sewer lines are being installed. Clay Pipe is being used *exclusively*, because it's the one material that's sure to be good as new long after the bond issue has been retired. Chemically inert Clay Pipe is *permanently* safe against corrosion from the acids and gases found in every form of sewage—residential or industrial. It stays true to dimensions—hot or cold, wet or dry, year in and year out. And today's longer, stronger Clay Pipe, developed through industry-wide research, is easier to install than ever before. A variety of new jointing methods and materials keep it leak-proof and infiltration-proof. Take advantage of *guaranteed performance* with Clay Pipe.

Officials directing the Sanford project include:

City Manager—Warren E. Knowles,

Consulting and Design Engineers—Robert M. Angas & Associates,

General Contractors—Bumby & Stimpson, McPoland Brothers, and the Hubbard Construction Co.

Vitrified CLAY PIPE NEVER WEARS OUT!

NATIONAL CLAY PIPE MANUFACTURERS, INC.
1820 N. Street, N.W., Washington 6, D. C.

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C-356-9

Progress in Public Health - Through Clay Pipe Research

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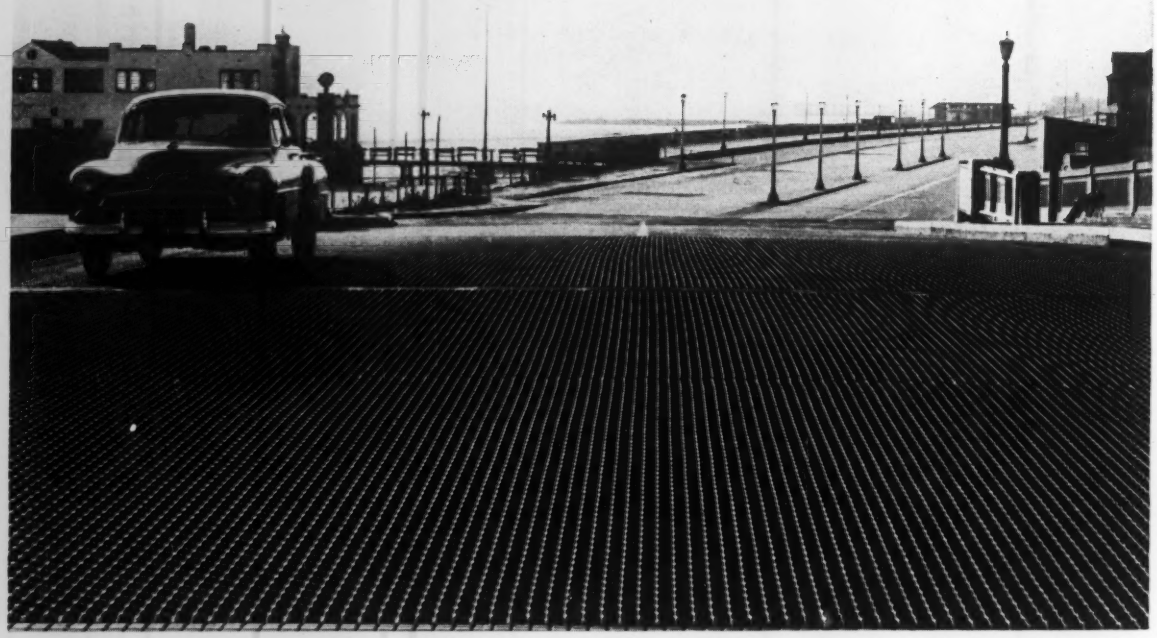
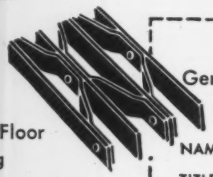
BORDEN *first* IN FLOOR GRATING



Borden Grating for Bridges and Roads

- **MAXIMUM TRACTION** — greater safety, cuts accumulation of ice, snow, oil or grease.
- **EASY TO INSTALL** — engineered in conveniently sized units for easy installation.
- **EXTRA STRONG** — reinforced, designed with maximum safety factor.
- **LIGHT WEIGHT** — approximately 80% open, reduces dead weight, allows greater live load.
- **SELF-CLEANING** — creates greater safety, economy of maintenance, no sweeping or washing required.



Write for complete information on BORDEN All/Weld, Pressure Locked, and Riveted Floor Gratings in this FREE 8-page catalog

BORDEN METAL PRODUCTS CO.

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SOUTHERN PLANT—LEEDS, ALA. — MAIN PLANT—UNION, N. J.

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CIVIL ENGINEERING

NOVEMBER 1956
VOL. 26 • NO. 11

THE MAGAZINE OF ENGINEERED CONSTRUCTION

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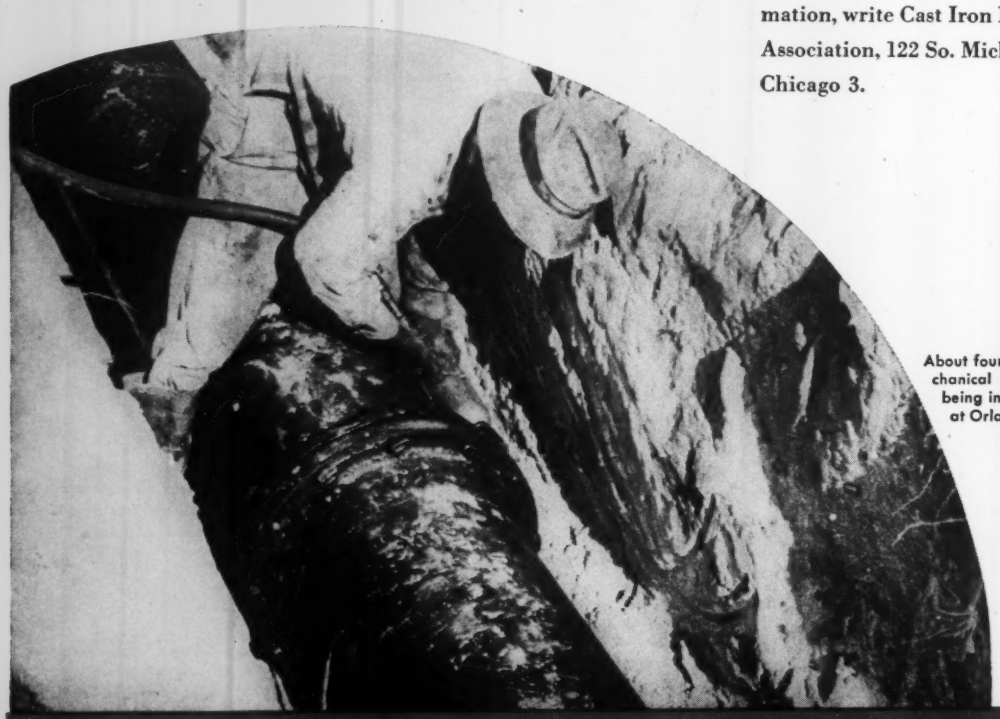
When you use it

Installing 6-inch Mechanical Joint cast iron pipe for pressure sewer river crossing to sewage treatment plant at Marquette, Mich.

If you were to put *your own money* in a pipeline that should be as nearly permanent as brains, hands and machines could make it, what pipe would you buy? Cast Iron Pipe, undoubtedly! And why? Because cast iron mains are in their *second century* of service in nearly *seventy* cities. *Modernized* cast iron pipe, as made today, is even tougher and stronger. Since everybody pays taxes, one way or another, everybody benefits when you install long-lived cast iron pipe. For further information, write Cast Iron Pipe Research Association, 122 So. Michigan Avenue, Chicago 3.



About four miles of 16-inch Mechanical Joint cast iron pipe being installed for water line at Orlando, Florida.

CAST IRON PIPE

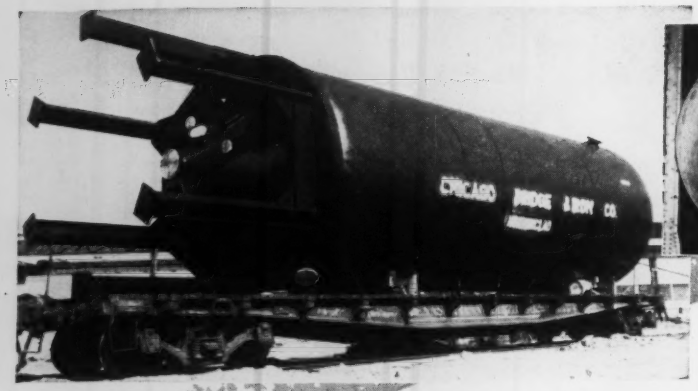
everybody benefits!

Laying 16-inch cast iron pipe for water line to new Caterpillar Tractor Company plant at Decatur, Illinois.

Tieing-in 16" Cement-lined cast iron feeder main with 133-year old cast iron water main in Philadelphia.

Laying 21,000 feet of 6" to 12" cast iron pipe for water main extension at North Brunswick Township, N. J.

SERVES FOR CENTURIES...



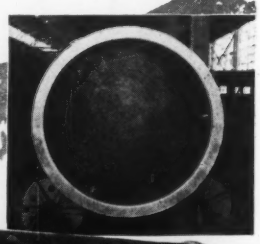
Left: 12-ft. O.D. by 43-ft. 4-in. digester with 316 E. L.C. Hortonclad. Inset: Interior of vessel built for Hudson Pulp and Paper Co. at Palatka, Florida.

HORTONCLAD and CB&I VESSELS

High Vacuum Brazing Process Assures Uniform Thickness of Clad Layer

Hortonclad®, available only with CB&I process and storage vessels, is a composite metal having an integral and continuous bond produced by a high vacuum brazing process. Uniform thickness is assured as the alloy cladding and the backing are in their final thickness before bonding. Hortonclad meets all ASME Boiler and Pressure Vessel Code and API-ASME Unfired Pressure Vessel Code requirements.

CB&I vessels can be fabricated using Hortonclad plates with silver, monel, Inconel, Hastelloy, stainless and a wide variety of other metals and alloys. Complete information on Hortonclad and its use with CB&I vessels may be obtained by writing our nearest office.



Above: A 36-ft. 9 15/16-in. shell section of this 43-ft. reactor has type 405 stainless steel Hortonclad. Inset: View inside of reactor supplied to the Derby Oil and Gas Co., Wichita, Kansas, through the Fluor Corp.

Above: 37 1/4-in. O.D. by 24-ft. 10 5/8-in. urea autoclave liner with fine silver Hortonclad. Inset: View of interior.

Chicago Bridge & Iron Company

Atlanta • Birmingham • Boston • Chicago • Cleveland • Detroit • Houston
New York • Philadelphia • Pittsburgh • Salt Lake City • San Francisco
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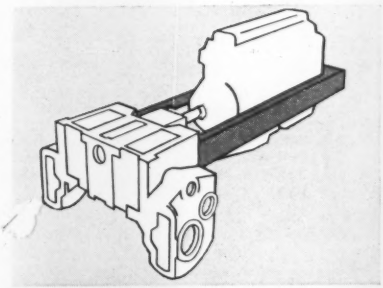
CB&I

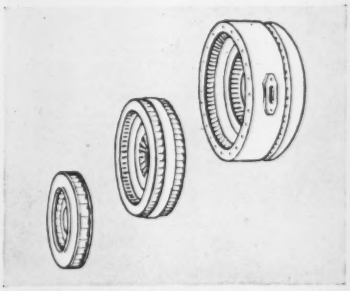
ALLIS-CHALMERS HD-21

Engineered to take the STRAIN, the SHOCK, and the GRIND of Modern Construction



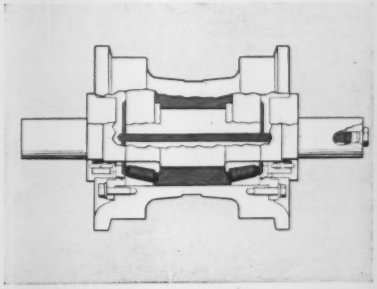
THE STRAIN

The Allis-Chalmers all-steel, Box-A Main Frame soaks up strains . . . does *not* use the engine as a structural member. It allows more efficient equipment mounting, provides excellent weight distribution and makes possible unit construction for unmatched servicing ease.



THE SHOCK

Sudden overloads are common in dozer operations. But hydraulic torque converter cushions shock, protects entire power train. This drive is standard equipment on the HD-21 and has been *proved* on Allis-Chalmers tractors since 1941.



THE GRIND

"Grinding compound" never reaches the truck wheel, support roller, idler and final drive bearings on an Allis-Chalmers tractor. Tapered roller bearings and *Positive* Seals keep dirt and moisture out and hold lubrication in for at least *1,000 hours* without lubricating attention.

HD-21
204 net engine hp
Approx. Weight (as illustrated)
51,845 lb

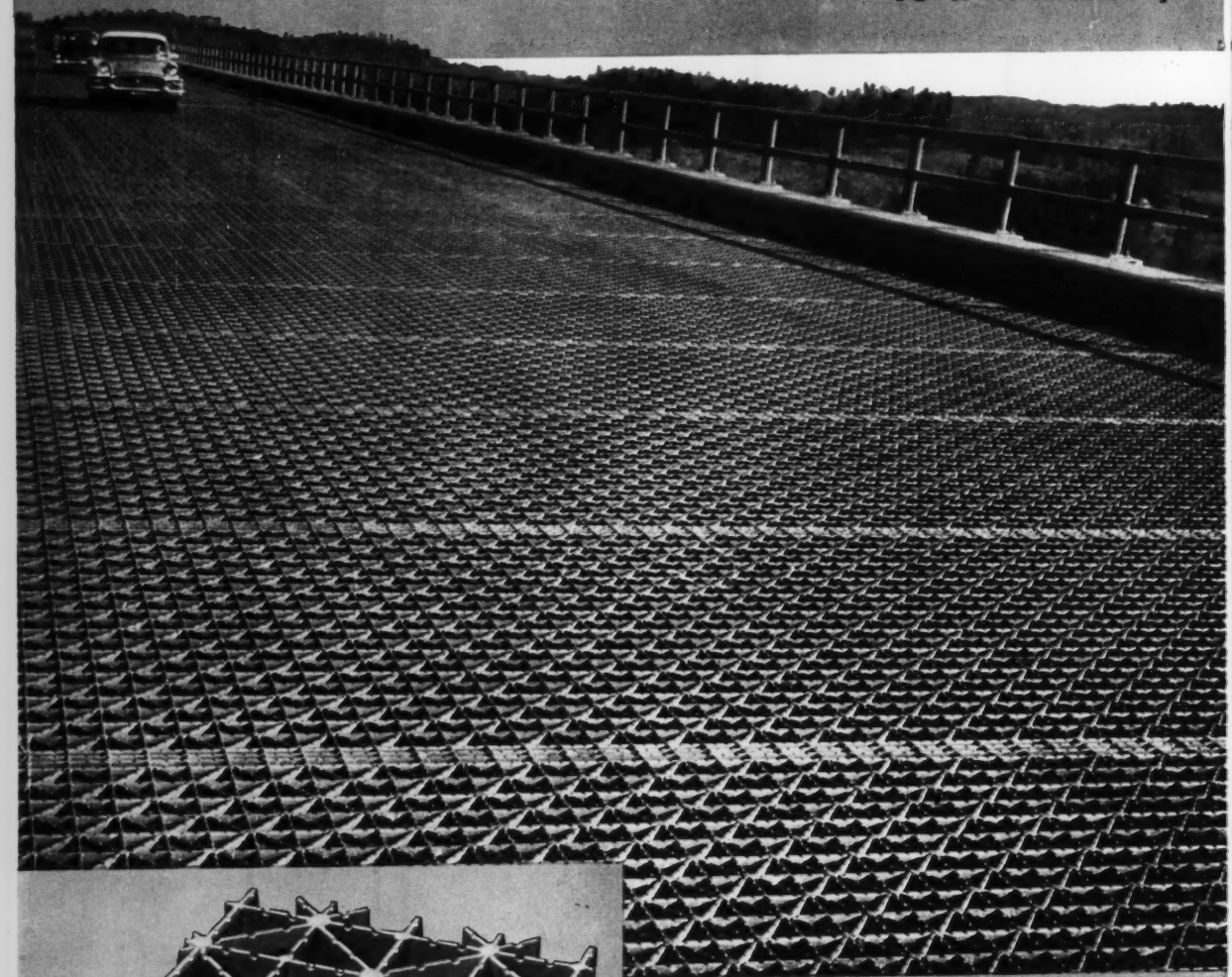
ALLIS-CHALMERS, CONSTRUCTION MACHINERY DIVISION, MILWAUKEE 1, WISCONSIN

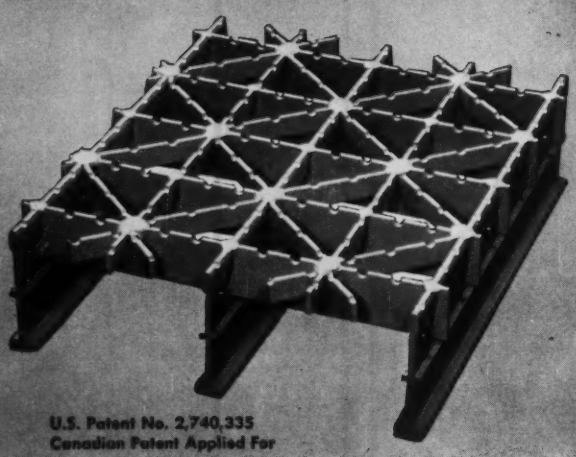
ALLIS-CHALMERS

Stronger, Quieter OPEN STEEL

New GREULICH 4-Way GRID

to a minimum,





U.S. Patent No. 2,740,335
Canadian Patent Applied For

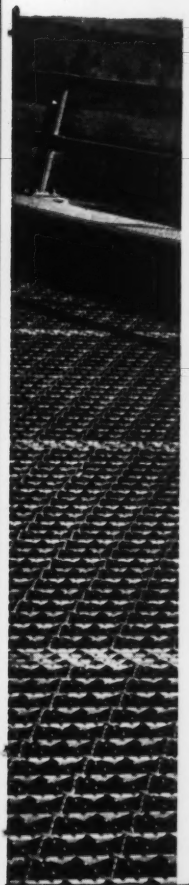
Greulich 4-Way Grids

Precision manufactured. Comes out square and rigid, assuring true alignment. Will not rack.

Integrally connected triangles extend over entire roadway insuring maximum lateral or horizontal rigidity and high skid resistance. They are especially adaptable for reflooring old bridges. Solid units remain true during shipment, handling and erection. Test data available proving resistance to distortion. Grids made in lengths up to 42 feet and 7 feet 3 inches standard widths to reduce number of units to be handled and field splices to be made between grids.

BRIDGE FLOORS *with* 20% Fewer *Field* Welds

from KERRIGAN holds installation and handling costs and provides a skid-resistant flat, serrated surface



The new Lanier Bridge, constructed by Bristol Steel and Iron Works for the U.S. Corps of Engineers, and built in conjunction with Buford Dam near Gainesville, Georgia, is floored with Kerrigan Iron Works' new GREULICH 4-WAY GRID. The Greulich 4-way design permits wider spacing of main bearing beams to 7½ inches, thus reducing the number of field welds necessary to secure flooring to supporting beams. Units are fabricated in panels 7 ft. 3 inches wide to hold handling costs to a minimum, and still permit hauling on ordinary flat bed trucks. The 4-way grid provides a flat single plane serrated surface—gives a smooth ride and reduces tire hum to a minimum. Yet, due to triangular opening in design and scientifically located serrations in the top surface, it provides greater skid resistance. The solid, one-piece unit is easy to erect and is self cleaning. The open surface does not hold snow, dirt and water.

This flooring is now being produced in our large, modern production plant, and a large reserve supply of materials is on hand to insure prompt delivery. For further information, write to

BRISTOL STEEL & IRON WORKS, INC.

DEPENDABLE STEEL SERVICE SINCE 1908

W. J. TILLEY, PRESIDENT — A. O. TILLEY, JR., EXEC'V. PRESIDENT

STRUCTURAL STEEL
STEEL PLATE AND COMPLETE WAREHOUSE SERVICE
DESIGNERS • FABRICATORS • ERECTORS
BRISTOL, VIRGINIA

May 7, 1956

Greulich Bridge Flooring Division
Kerrigan Iron Works, Inc.
1033 Herman Street
Nashville, Tennessee

ATTENTION: Mr. Harvey Neel,
Special Representative

Gentlemen:

We want to make a few comments on our experience with the use of Greulich Bridge Flooring on Lanier Bridge. From the field point of view we find your grating advantageous in several ways. The larger units meant fewer pieces to handle and fewer splices to weld. The 7-1/2 inch spacing of main members meant fewer welds to supporting steel.

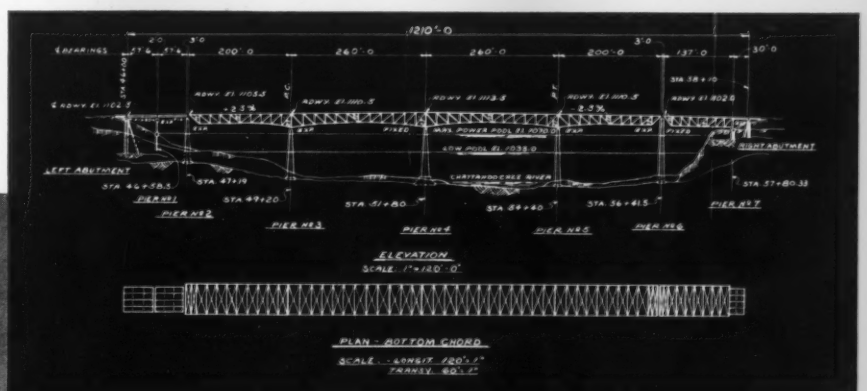
We would like to make a comparison between your grating and that of another design on a neighboring bridge. The intensity of hum as rubber-tired cars cross the bridge is of concern to those who must hear it. The hum from your grating is only a small fraction of that of a competing type, a strong selling point in our estimation.

You can be sure that we will again give serious consideration to the use of Greulich Grating on our next bridge where grating is specified.

Yours very truly,

BRISTOL STEEL & IRON WORKS, INC.

CUYLAR S. POOR
Manager of Erection



GREULICH
Bridge Flooring Division

KERRIGAN IRON WORKS, Inc.

Harvey F. Neel, Manager, Bridge Flooring Division, Nashville, Tenn.
General Sales Office: 274 Madison Avenue, New York City

By changing the character of hormones and genes science may increase tremendously the size of fowl and domestic animals . . . put more meat at less cost on the American table.

100 years from now...

WE MAY RAISE CHICKENS AS BIG AS OSTRICHES!

How will we live, eat, travel in the future? Even scientists must include some guesswork in their predictions of the marvelous things to come. But one thing seems certain—water and gas will still be carried by the dependable, long-lasting cast iron pipe laid today. Here's proof! More than sixty American cities are still being served by cast iron water and gas mains over a century old. And today's modernized U. S. Pipe...centrifugally cast, quality controlled...is even stronger, tougher, and more durable.

U. S. Pipe is proud to be one of the leaders in a forward-looking industry whose service to the world is measured in centuries.

U.S.
cast iron
PIPE
FOR WATER, GAS, SEWERAGE AND INDUSTRIAL SERVICE
CAST IRON

U. S. PIPE AND FOUNDRY COMPANY, General Office: Birmingham 2, Alabama

A WHOLLY INTEGRATED PRODUCER FROM MINES AND BLAST FURNACES TO FINISHED PIPE.

Now . . . a complete work station in only 32 square feet

THESE FEATURES MAKE
DRAFT-A-MATIC
WORLD'S FINEST

- **All metal construction with baked-on finish. No warping.**
- **Velvoleum covered drafting platform adjustable 0 to 85°.**
- **Height of entire unit adjustable from 30" to 39" at 1" intervals.**
- **Large center drawer. Locking instrument tray.**
- **Shelf and storage drawer arrangements to suit individual needs.**
- **Large sliding reference shelf for extra convenience.**
- **Designed for space-saving row installation.**
- **Accommodates parallel straight edge, drafting machine, lamp.**
- **Exclusive Flexi-Belt and Roto-Positioner delivers the work to the man.**

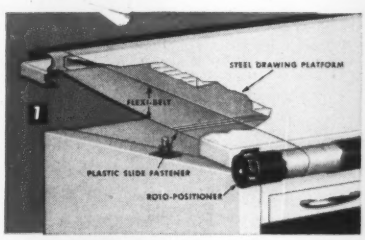
Save valuable floor space with the new GF Draft-a-Matic®

When you install Draft-a-Matic you can conveniently accommodate one-third more draftsmen than with conventional desks and equipment.

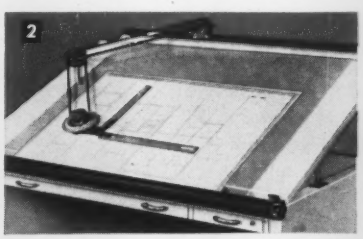
The draftsman needs only to make a half turn in his comfortable, adjustable office chair and there at his finger-tips are shelves for reference material, storage or file drawers and a sliding, Velvoleum covered work shelf. Drawer and shelf arrangement is flexible and can be tailored to individual needs or preference.

Draft-a-Matic not only solves the space problem—it boosts efficiency because the draftsman can perform his entire job while comfortably seated.

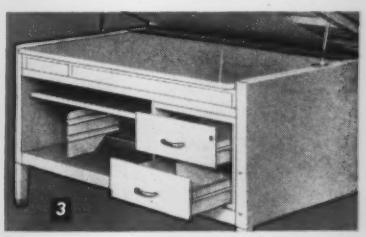
To learn the many ways Draft-a-Matic can help reduce your engineering costs, see it now at your local GF showroom, listed in the Yellow Pages. Or write for free 8-page Draft-a-Matic booklet. The General Fireproofing Company, Department C-60, Youngstown 1, Ohio.



1. *Drawing is affixed to endless vinyl plastic belt. By merely turning Roto-Positioner wheel, draftsman moves drawing into working range while remaining comfortably seated.*



2. *Draft-a-Matic will accommodate drafting machine, parallel straight edge, lamps and similar accessories. Drawing platform is covered with Mist Green Velvoleum.*

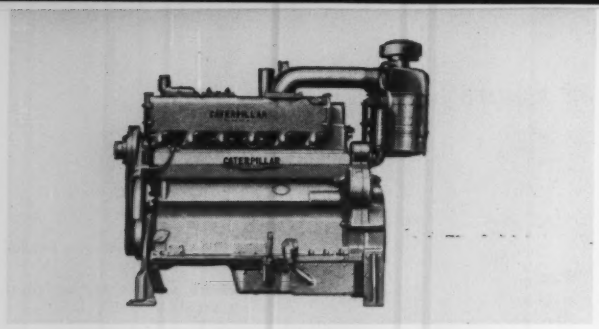


3. *Draftsman is surrounded by storage space so arranged as to serve best his individual requirements. This generally eliminates the need for additional files and book shelves.*

MODE-MAKER DESKS • GOODFORM ALUMINUM CHAIRS
SUPER-FILER MECHANIZED FILING EQUIPMENT • GF ADJUSTABLE STEEL SHELVING

GF metal business furniture is a **GOOD** investment

GENERAL FIREPROOFING
Foremost in Metal Business Furniture



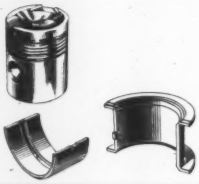
A QUARTER CENTURY OF

A CATERPILLAR FIRST
—the "Hi-Electro" hardened cylinder liner

A CATERPILLAR FIRST
—the chemically conditioned cylinder liner

A CATERPILLAR FIRST
—the stainless-steel piston protector

A CATERPILLAR FIRST
—the steel-backed aluminum bearing



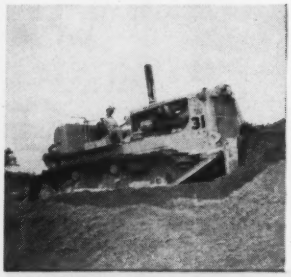
A quarter of a century ago, Caterpillar created mobile diesel power. For the first time, the power of the diesel engine was unleashed from its bulky foundations and put to work in the field—compact, economical. Here was diesel power of simple design, with no need for experts to operate and maintain. Here was diesel power with the lugging ability to knuckle down to the tough jobs.

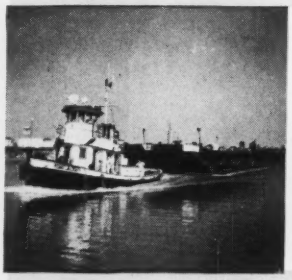
The introduction of mobile diesel power was a tremendous advance in many fields. It provided efficient diesel power for tractors, motor graders, earthmoving equipment . . . for the work boat, the gin, the locomotive, the oil rig, the municipal plant . . . for *any* application in which steady, low-cost power is crucial. And everywhere, CAT* Diesel Engines proved themselves durable and dependable. They established Caterpillar as the leader in diesel engineering.

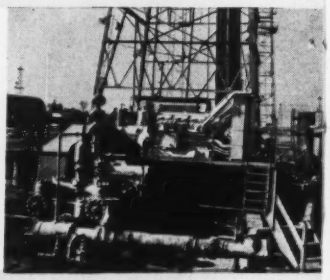
Today, hundreds of thousands of modern heavy-duty Cat Diesels are on the job in every corner of the world. And still the research continues. Study and experiment go ahead constantly in Caterpillar laboratories. Special testing machines help point the way toward new advances. Manufacturing techniques improve, too, in the world's largest diesel engine factory—where the quality of workmanship is the standard for the industry.

A modern world must have modern power—more and more of it. It is coming, in ever increasing quantity, from the production lines of Caterpillar, the leader.

Caterpillar Tractor Co., Peoria, Illinois, U. S. A.







CATERPILLAR*

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DIESEL POWER FOR PROGRESS

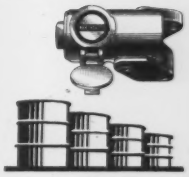
DIESEL LEADERSHIP

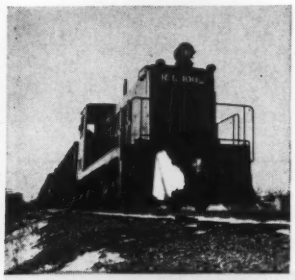
A CATERPILLAR FIRST
—interchangeable, adjustment-free fuel injection equipment

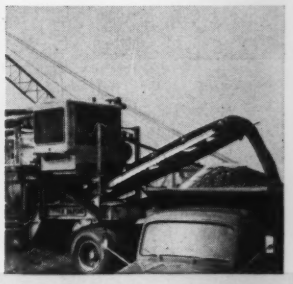
A CATERPILLAR FIRST
—the capsule-type injection valve

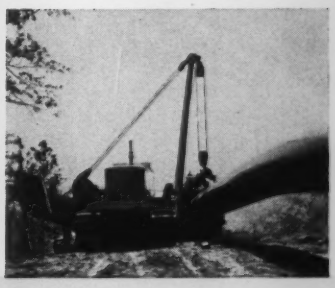
A CATERPILLAR FIRST
—the service meter

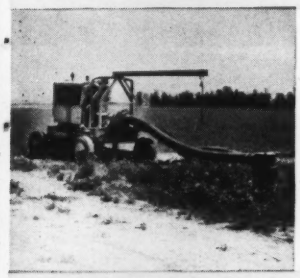
A CATERPILLAR FIRST
—superior lubricants (detergent oils)

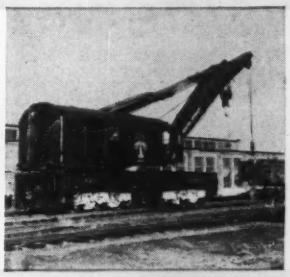


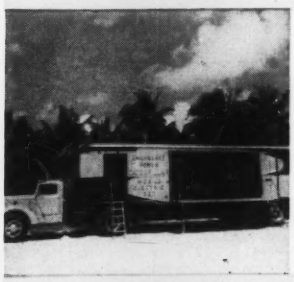






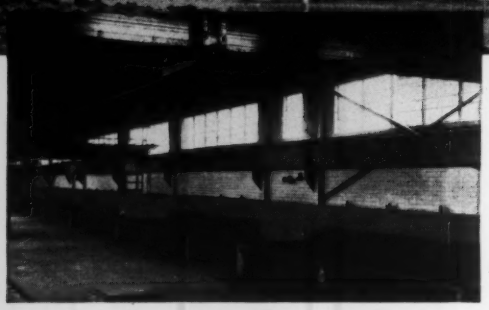






800

more tons per day
of incineration for
BALTIMORE, MD.



charging floor

stoking floor

PITTSBURGH • DES MOINES *Incineration Plants*

Matching Baltimore's civic growth, this great new 800-ton Pittsburgh-Des Moines Incineration Plant is the city's second large PDM unit. Employing mechanical stoking for its four furnaces, the new plant has operated steadily beyond rated capacity from the first day in service. *Send for our latest Modern Refuse Incineration Brochure.*

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MADRID, SPAIN . . . . Diego DeLeon. 60

AUSTIN-WESTERN HYDRAULIC CRANE

Converts Storage Yard into a Warehouse for ONEIDA, LTD.

Versatile Crane Solves Storing—Warehousing—Handling Problems

Does Twice as Much Work with Less Effort

Here's what they say...

"Before we had our present complete unit, we used to skid heavy machinery half a mile down the road from the siding and into the plant where perhaps an overhead crane would place it. Now, the hydraulic boom of our Austin-Western crane handles any machine up to 5 tons in weight. It reaches in a freight car or skids a machine out onto the trailer and hauls it in short order into the plant aisle, very likely right to the point where it is to be set up, and lifts it into the place where it belongs."

"We have literally made a warehouse out of our storage yard with every location clearly marked and cases carefully piled in the places assigned to them."

"Hard to handle items, like telephone poles, are easy for our combination crane and trailer."

"Here in our main Plant a truckload of 12 drums, weighing from 1000 to 1800 pounds each, formerly caused heavy maintenance expense and downtime on our old truck and crane. Our Austin-Western equipment could handle twice this load with no trouble."

"The average for the last few months has shown more than 150 hours a month active service for our crane and trailer unit."

"A two-way radio in the crane cab and on each of our ten trucks enables the unit to save waste time, avoid doubling back and empty hauls."

For the complete Oneida Ltd. story, ask for Gould Certified Report No. 5511.

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628 Farnsworth Avenue, Aurora, Illinois
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65 major bridges have been

USS HIGH STRENGTH STEELS

—the big step forward in bridge construction

built with USS High Strength Steels

—and every month the list is growing

NOTHING SUCCEEDS like success. Less than ten years ago, the bridges built with USS high-strength, low-alloy steels could be counted on the fingers of one hand. But look around the country today and you'll find 65 major bridges that have been built with stronger, more durable USS High Strength Steels.

This phenomenal growth in the use of USS High Strength Steels is the result of an ever-increasing recognition of their advantages. Bridge engineers have found in steels like USS MAN-TEN and USS TRI-TEN "E" *superior* materials of construction with which they can (1) obtain greater strength with no increase in weight, (2) reduce weight without any sacrifice in strength, (3) insure greater durability, and (4) frequently reduce costs as well.

Here are some of the prominent bridges which have benefited by the use of USS High Strength Steel:

USS MAN-TEN STEEL

Ohio River Bridge, Wheeling, W. Va.	2,500 tons
Maumee River Bridge, Toledo, Ohio	1,913 tons
Delaware River Turnpike Bridge	11,070 tons
Red River Bridge, Shreveport, La.	2,000 tons
St. Charles Bridge, St. Charles, Mo.	3,230 tons
Penn-Lincoln Parkway Ramp, Pittsburgh, Pa.	2,300 tons
Pass Manchac Bridge, Pontchatoula, La.	1,360 tons
Inner Belt Freeway Bridge, Cleveland, Ohio	4,800 tons
Canal Bridge, Orleans Parish, La.	1,635 tons

USS TRI-TEN "E" STEEL

Columbia River Bridge, Umatilla, Ore.	1,864 tons
Paseo Bridge, Kansas City, Mo.	3,759 tons
Ohio River Bridge, Shawneetown, Ill.	2,295 tons
Missouri River Bridge, Jefferson City, Mo.	1,692 tons
Kansas Turnpike Bridge	1,800 tons
Missouri River Bridge, Kansas City, Mo.	1,525 tons

We think this list, though far from complete, speaks for itself. Significant, too, is the fact that USS High Strength Steels are being specified for many of the major bridges projected for the immediate future.

We will be glad to discuss with you how these superior structural steels can be incorporated into your designs to provide maximum strength, safety and durability with a minimum of weight and cost.

UNITED STATES STEEL CORPORATION, PITTSBURGH • AMERICAN STEEL & WIRE DIVISION, CLEVELAND
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO • NATIONAL TUBE DIVISION, PITTSBURGH
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USS

UNITED STATES STEEL

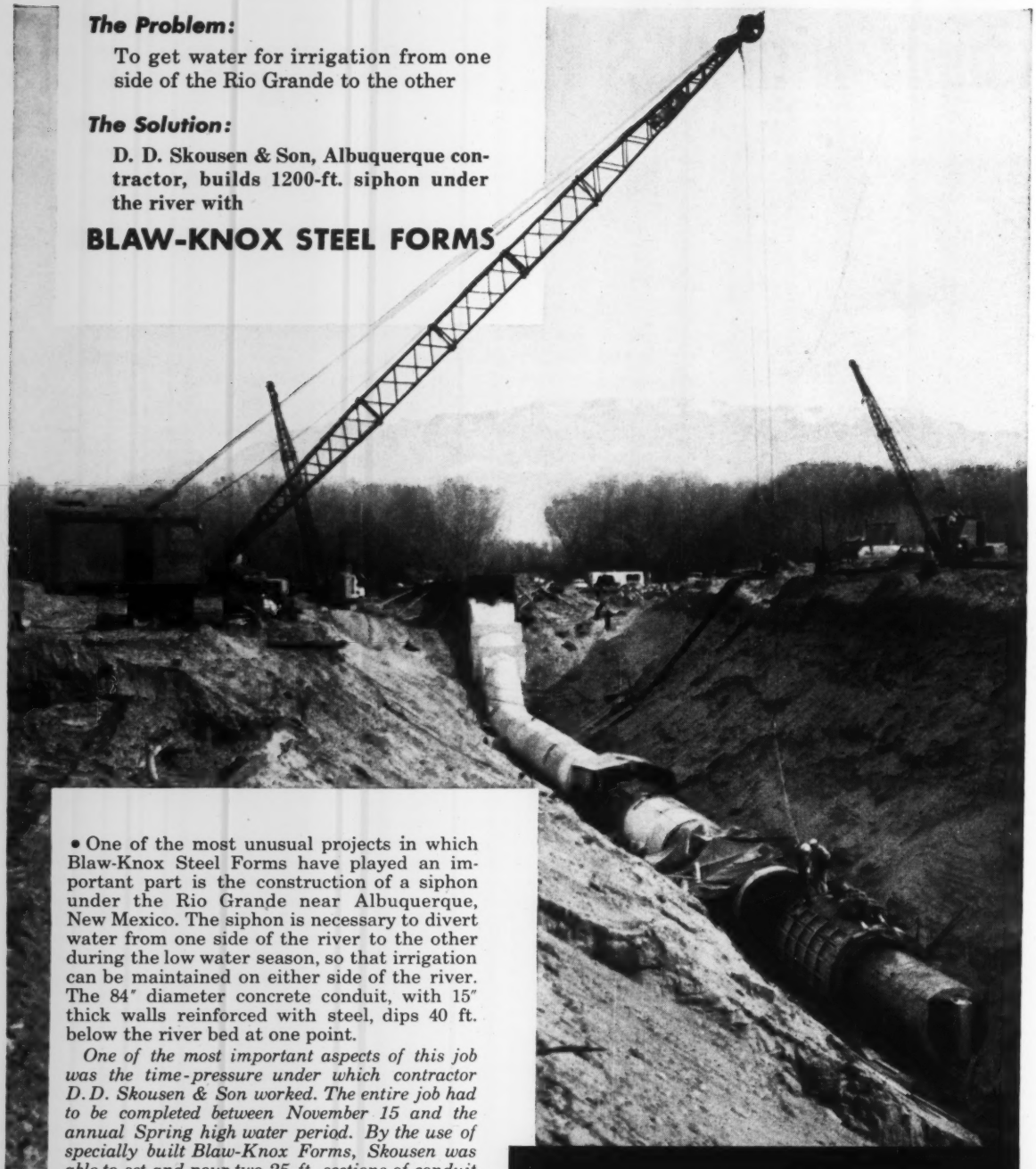
The Problem:

To get water for irrigation from one side of the Rio Grande to the other

The Solution:

D. D. Skousen & Son, Albuquerque contractor, builds 1200-ft. siphon under the river with

BLAW-KNOX STEEL FORMS



• One of the most unusual projects in which Blaw-Knox Steel Forms have played an important part is the construction of a siphon under the Rio Grande near Albuquerque, New Mexico. The siphon is necessary to divert water from one side of the river to the other during the low water season, so that irrigation can be maintained on either side of the river. The 84″ diameter concrete conduit, with 15″ thick walls reinforced with steel, dips 40 ft. below the river bed at one point.

One of the most important aspects of this job was the time-pressure under which contractor D.D. Skousen & Son worked. The entire job had to be completed between November 15 and the annual Spring high water period. By the use of specially built Blaw-Knox Forms, Skousen was able to set and pour two 25-ft. sections of conduit per day. Working seven days a week, the project was completed without delay.

Siphons, Sewers, Big Dams, Bridges— whatever your concreting problem — solve it the low-cost way by taking advantage of Blaw-Knox forming experience. Bulletin 2430 contains special design suggestions and complete details about the Blaw-Knox Steel Form Consultation Service. Send for it *today*, while your next job is in the preliminary planning stage.

BLAW-KNOX COMPANY
STEEL FORMS DEPARTMENT
BLAW-KNOX EQUIPMENT DIVISION
P.O. BOX 1198 • PITTSBURGH 30, PA.
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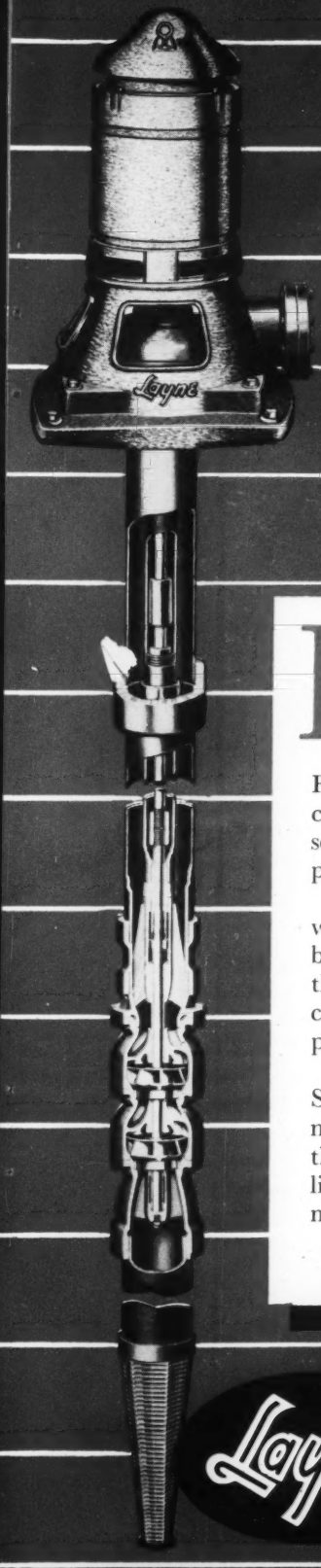
BLAW-KNOX STEEL FORMS CONSULTATION SERVICE

50th Anniversary
BLAW-KNOX
1906-1956



Rx Making sick wells . . . WELL!

First comes diagnosis. Before the cure the trouble must be known so that proper treatment may be prescribed.

Trained Layne research men, with the help of the latest and best in scientific equipment, find the trouble . . . determine the corrective measures . . . and experts go to work.

Successful? . . . One smaller Southern city saved the cost of a new well at a nominal cost. And that's just one success in a long line of sick wells that have been made well by Layne.

The nearest Layne associate company will be glad to discuss such problems with you—without obligation. It's another Layne service that proves it's always wise first to "ASK THE MAN FROM LAYNE" on any phase of water development or maintenance.

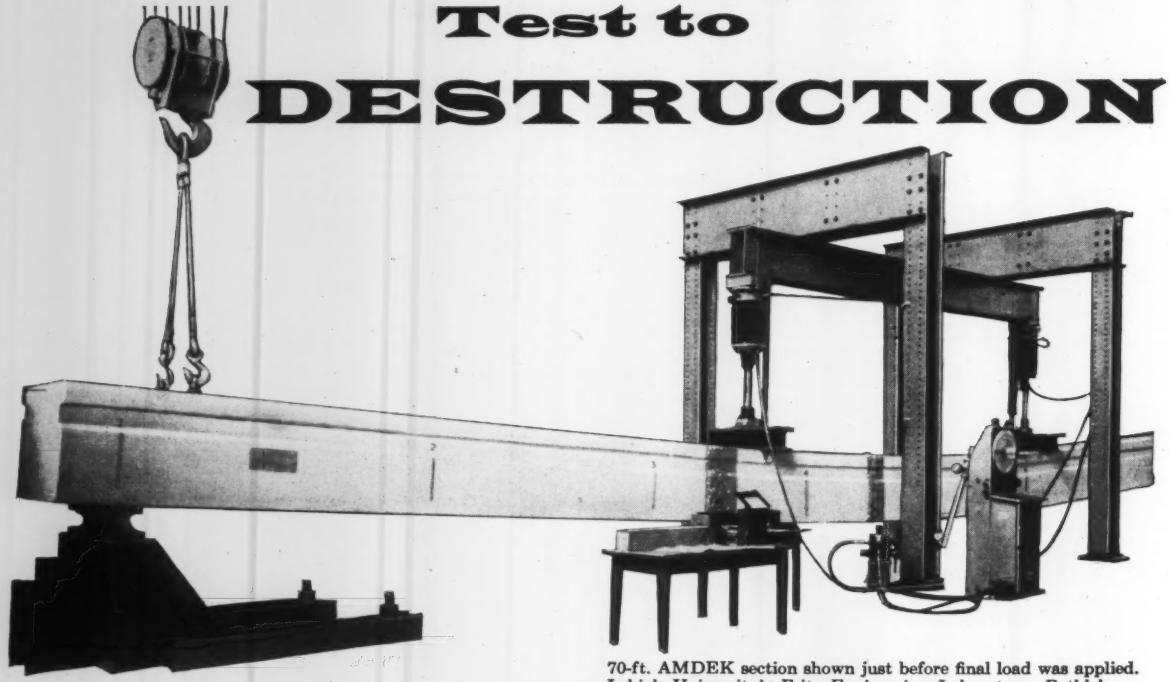
LAYNE
& BOWLER, INC.
MEMPHIS
General Offices and Factory

LAYNE ASSOCIATE COMPANIES THROUGHOUT THE WORLD

Layne

Water Wells • Vertical Turbine Pumps • Water Treatment

Test to DESTRUCTION



70-ft. AMDEK section shown just before final load was applied. Lehigh University's Fritz Engineering Laboratory, Bethlehem, Pa., conducted the tests for American-Marietta Company.

proves exceptional strength of

AMDEK Prestressed Pretensioned Concrete BRIDGE SUPERSTRUCTURES

Thorough *FULL SCALE* testing of AMDEK design shows the "box section" develops superior rigidity, and strength. Prestressed, pretensioned, vacuum processed—and using special rectangular voids—AMDEK sections are stronger, longer, and lighter. Ease of handling has made AMDEK a favorite among erection engineers and contractors.

Save time—cut costs—build AMDEK bridges in days, that stay beautiful for years with little maintenance.

Copies of recent *FULL SCALE* tests using both static, and dynamic loading are available to bonafide engineering firms, and governmental agencies. Please send your request on your letterhead and ask for a representative to call on you.

Our technical staff will be pleased to assist you with your pipe problems.

AMERICAN-MARIETTA COMPANY
CONCRETE PRODUCTS DIVISION
GENERAL OFFICES:
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EIMCO 105 -- MORE POWER FOR MORE WORK

Eimco 105 Tractor-Excavators are balanced to give maximum work efficiency in every phase of digging and loading. Compare these figures—(A) 39,200 pounds of digging force at the bucket lip as the 105 moves into the rock pile; (B) 39,200 pounds of lifting capacity for breakout power.

This power gives the operator the same potential in productive capacity as he would have if you bought him a boom type shovel costing three to four times as much.

How does Eimco design a small (1½ yard) Tractor-Excavator to outproduce every other machine in its price range?

The answer to this is Eimco's unique Tractor design which provides better balance, lower center of gravity and delivers full engine horsepower to the bucket at all times.

Eimco also makes it easier to operate the 105 Tractor-Excavator. The operator sits up front where he can see what he is doing. Two small handles, easily held in one hand, control all movements of the Tractor. The operator does more work with less effort, stays efficient the entire shift.

Other firsts in the Eimco 105 Tractor-Excavator include (1) independent track control so that one track can be run forward while the other turns reverse; (2) separate final drives for each track; (3) full track oscillation on the tractor when equipped with loading or excavating attachment; (4) elimination of master clutch and drag-track steering; (5) Unidrive transmission in which gearing always rotates in the same direction; (6) all alloy steel construction; (7) clutches that never need adjustment — and many other exclusive features.

See these completely new tractors as Bulldozers, Excavators or Loaders working near you. Write for complete information.

THE EIMCO CORPORATION

Salt Lake City, Utah—U.S.A. • Export Offices: Eimco Bldg., 52 South St., New York City

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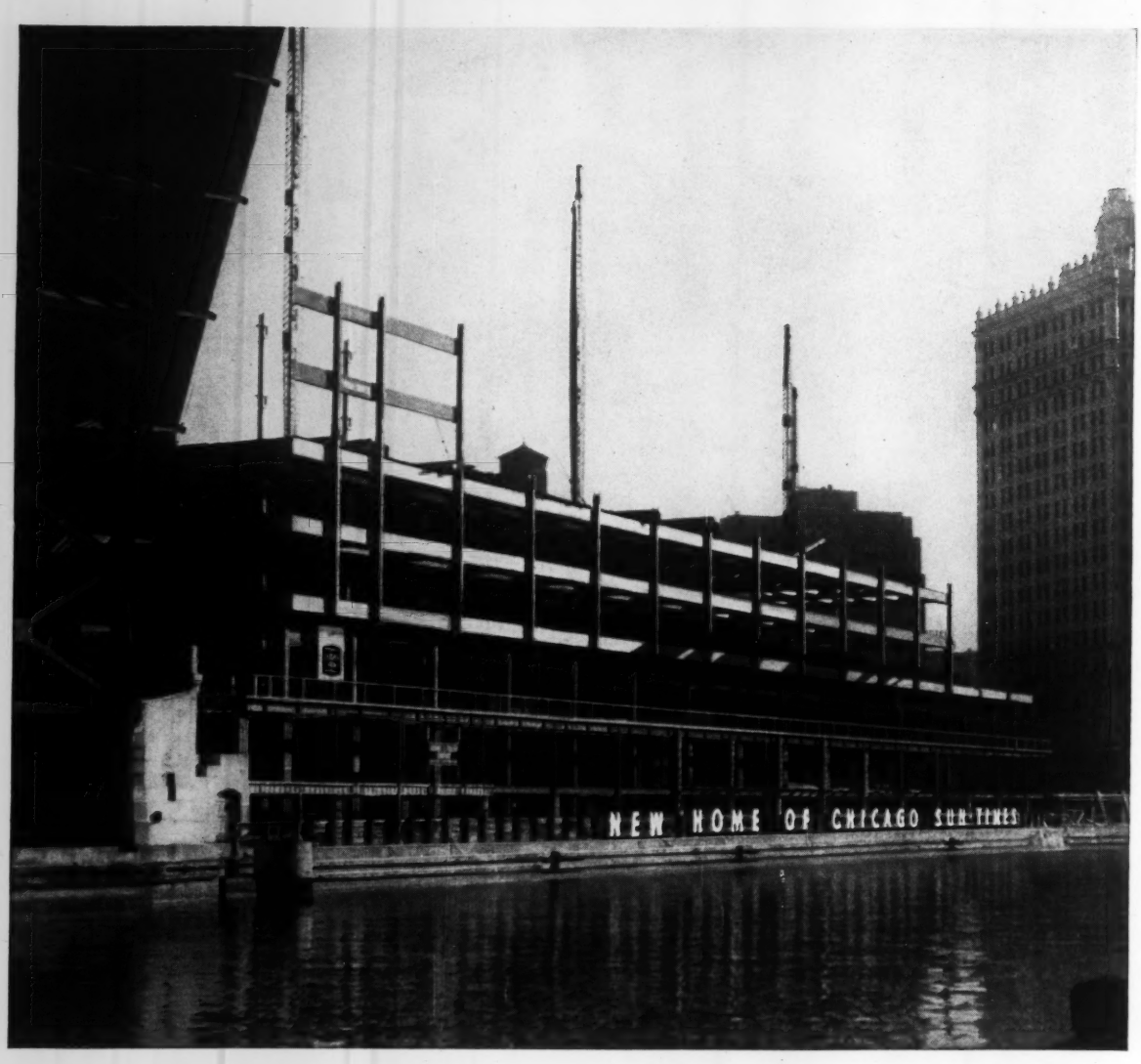
EIMCO

B-222



Steel Rising for Chicago Newsplant

If you're familiar with Chicago you'll quickly recognize this spot. That's the Chicago River in the foreground, and part of the well-known Wrigley Building appears at right.

Those steel beams and columns, fabricated and erected by Bethlehem, are part of what will soon be another Windy City landmark — the new Sun-Times newspaper plant. It will be a splendid structure, said to be the world's most modern of its type. Modern too is the use of high-strength structural bolts during erection, an advancement in which Bethlehem has been a pioneer.

The new newspaper plant will have ten acres of floor space. The structure will house executive, editorial and business offices, as well as new presses capable of rolling off 120,000 papers an hour. Total height of the building will be nine stories, with two of them below street level. Some upper floors will be available for rental to commercial tenants.

Owner: Field Enterprises, Inc.; Architect: Naess and Murphy; General Contractor: George A. Fuller Company.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

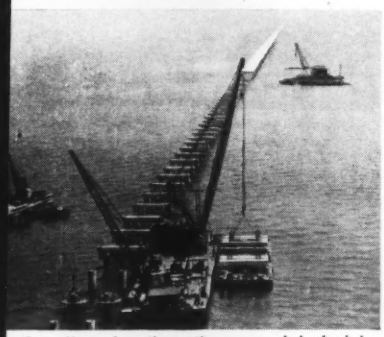
BETHLEHEM STEEL

LAKE PONTCHARTRAIN CAUSEWAY

New Orleans, Louisiana

OWNER: Greater New Orleans Expressway Commission. DESIGNER: Palmer & Baker, Inc., Mobile, Alabama. CONTRACTOR: Louisiana Bridge Co. (a joint venture of Brown & Root, Houston, Texas and T. L. James & Co., Ruston, La.)

The world's longest highway bridge rests on RAYMOND CYLINDER PILES



Installing the piles, pile caps and deck slabs.

The 37 acre manufacturing yard, built specifically for this job.

By using simplified design and unique assembly line construction methods, the $30,700,000 new Lake Pontchartrain Causeway, stretching 24 miles from the outskirts of New Orleans to Mandeville, La., was completed four months ahead of schedule. The use of Raymond Prestressed Concrete Cylinder Piles was a major factor in the saving of time and money in this project. Under the direction of Raymond engineers, a pile fabrication yard was constructed at the bridge site. Just three months after the manufacturing yard was started, the first Raymond Cylinder Pile came off the assembly line and was floated to the installation point. In all, the contractor, who was licensed to manufacture and install the Raymond Piles, used 4,886 fifty-four inch piles averaging 88 feet in length, 2,240 pile caps and 2,232 185-ton Prestressed Deck Slabs in the bridge.

Naturally, we are proud to have played such an important part in this gigantic construction achievement. And we will be equally proud to apply our experience to your foundation problems—no matter how large or small.

RAYMOND AROUND THE WORLD FOUNDED 1891 at home and abroad

IN THIS COUNTRY

Foundations . . . Marine Structures . . .
Heavy Construction . . . Soil Investigations.

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Complete services for all types of construction.

RAYMOND CONCRETE PILE CO.

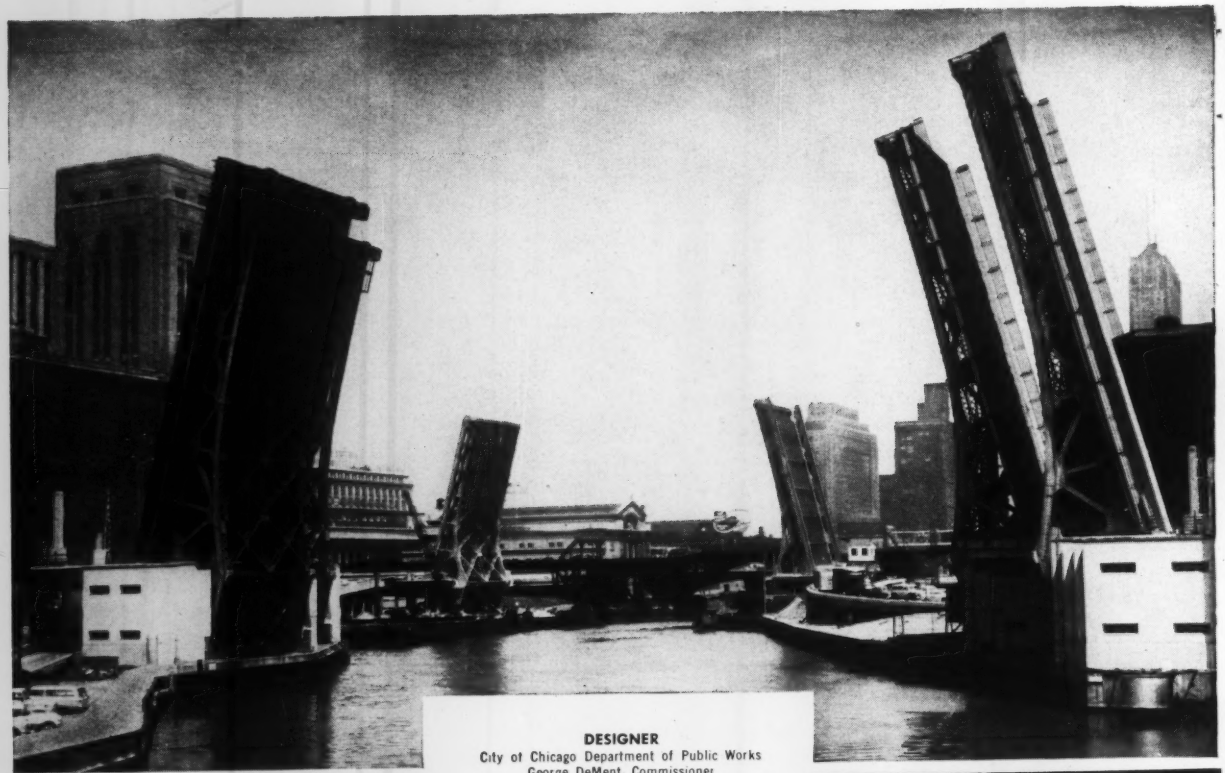
140 Cedar St., New York 6, N.Y.

Branch offices in Principal Cities of the United States, Canada, Central and South America

On Two New Bascule Bridges in Chicago—

Safe All-Weather Roadways

eliminate 896 tons of flooring deadweight

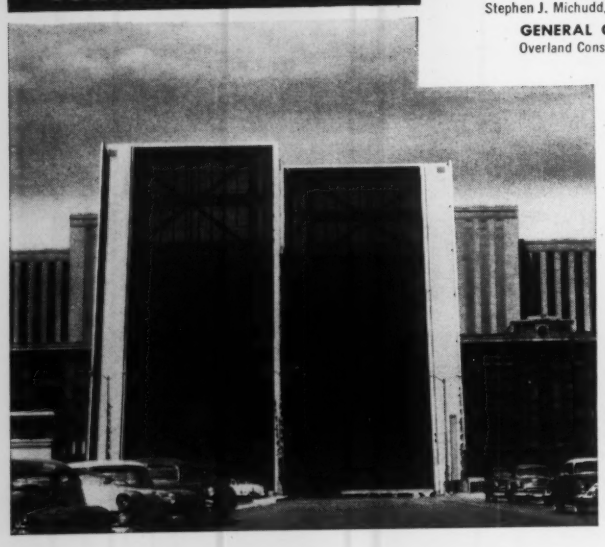


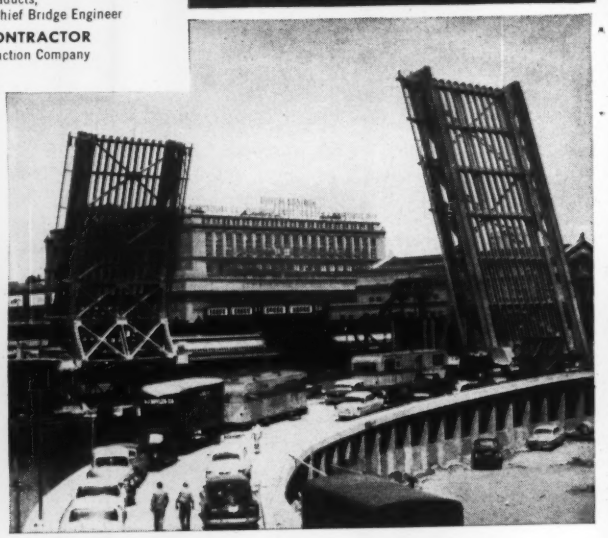
CONGRESS ST. BRIDGE

VAN BUREN ST. BRIDGE

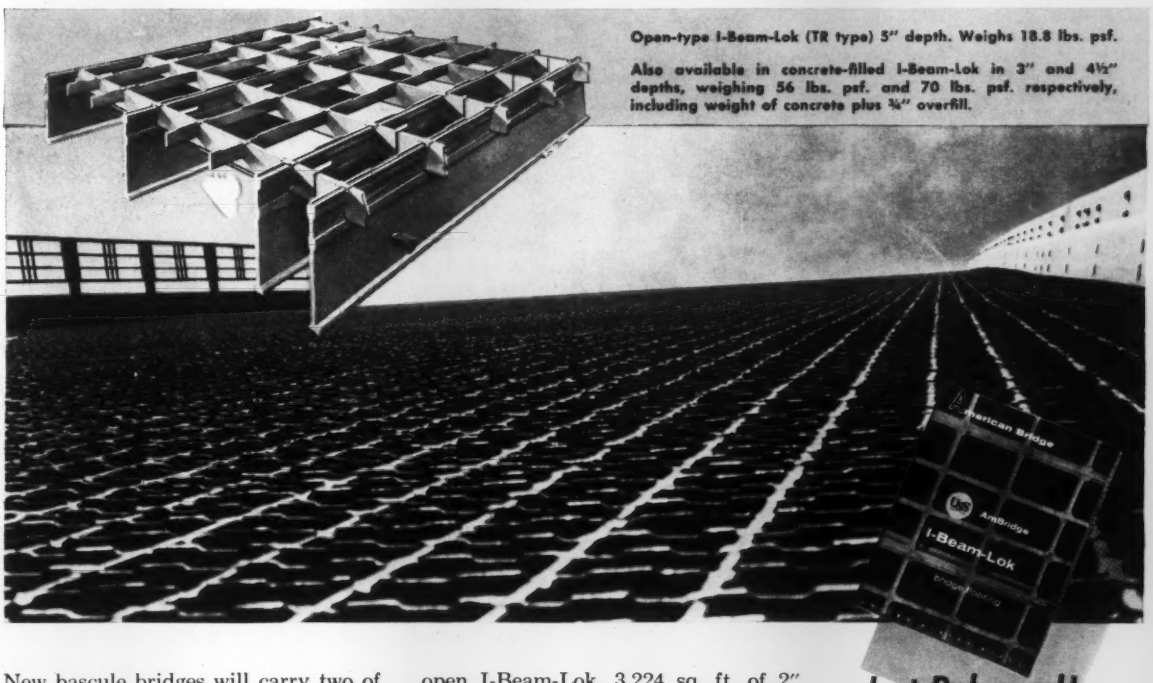
DESIGNER
City of Chicago Department of Public Works
George DeMent, Commissioner
Bureau of Engineering, Division of Bridges and Viaducts,
Stephen J. Michudd, Chief Bridge Engineer

GENERAL CONTRACTOR
Overland Construction Company





# of USS AMBRIDGE I-BEAM-LOK



Open-type I-Beam-Lok (TR type) 5" depth. Weighs 18.8 lbs. psf.

Also available in concrete-filled I-Beam-Lok in 3" and 4½" depths, weighing 56 lbs. psf. and 70 lbs. psf. respectively, including weight of concrete plus ¾" overfill.

New bascule bridges will carry two of the city's busiest thoroughfares over the Chicago River. One is the Congress Street Bridge, now open to traffic, and the other is the Van Buren Street Bridge, soon to be opened. The roadways of both crossings are of lightweight USS AmBridge Steel Flooring.

THE CONGRESS STREET BRIDGE, in the foreground of the picture on the opposite page, consists of two double-leaf, deck truss, trunnion bascule bridges. They are parallel but staggered 31′-7 5/16″. Each is 244′-8¾″ long, c-c of trunnions, and has a 43′ roadway and a 9′-8″ sidewalk. 19,033 sq. ft. of 5″ open USS AmBridge I-Beam-Lok flooring was used for the roadways, and 3,846 sq. ft. of 2″ Tee-type concrete-filled sidewalk flooring for the walkways.

THE VAN BUREN STREET BRIDGE, in the background of the picture, is a double-leaf, trunnion bascule bridge, 210′-4″ long, c-c of trunnions. It has a 44′ roadway and two 8′-3″ sidewalks. The roadway is floored with 8,475 sq. ft. of 5″ open I-Beam-Lok. 3,224 sq. ft. of 2″ Tee-type concrete-filled sidewalk flooring was used for the walkways.

If the roadways of these important, heavily traveled bridges had been floored with conventional 7″ concrete slabs instead of open I-Beam-Lok, total floor weight would have been 1,155 tons, or about 3½ times heavier than the 259 tons of I-Beam-Lok involved.

USS AmBridge I-Beam-Lok open-type steel flooring is available in units up to 6′-2″ in width and up to 49′ in length. This lightweight, all-steel flooring with its strong, full 5″ depth can be applied directly to stringers on spans up to 4′ centers to permit H-20 loadings. It does not require secondary supports. It combines weight saving and reduced cost with roadway rigidity, ease of erection, and low maintenance costs. For more information about the time- and money-saving advantages of this lightweight steel flooring in bridge construction, contact the sales office nearest you.

Just Released!
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NEWS OF ENGINEERS

Paul D. Berrigan, Brigadier General, U. S. Corps of Engineers, has been given a recess appointment to serve as a member of the Mississippi River Commission in addition to his other duties as North Central Division Engineer for the Corps of Engineers at Chicago, Ill. The appointment is subject to confirmation by the Senate. The other members of the seven-member Mississippi River Commission are: **Maj. Gen. John R. Hardin,** Vicksburg, Miss., president; **Rear Admiral H. Arnold Karo,** Washington, D. C.; **Dewitt L. Pyburn,** Baton Rouge, La.; **Eugene F. Salisbury,** Kansas City, Mo.; **Harry L. Bolen,** Cairo, Ill.; and **Brig. Gen. Lyle E. Seeman,** Dallas, Tex.

Harold M. Sylvester was recently appointed special assistant for maintenance to the Assistant Secretary of Defense for Properties and Installations. Mr. Sylvester was formerly director of field service with the Building Research Advisory Board in Washington.

James M. Montgomery, consulting engineer of Pasadena, Calif., announces the relocation of his offices at 535 East Walnut Street, Pasadena.

Kurt Billig of London, England, professor of civil engineering and former director of Indian Building Research, has accepted an appointment of the United Nations Technical Assistance Administration as dam construction expert and consultant to the Pakistan Government. Dr. Billig is an international authority on prestressed concrete and has lectured in the United States on recent developments in the field.

Kurt Billig

Roy F. Weston and **William W. Eckenfelder** have established a consulting sanitary engineering office under the firm name of Weston, Eckenfelder and Associates in Newton Square, Pa. The firm will specialize in industrial water supply and water and air pollution control. At present the research and development phases of the firm's work are being carried out in New York City. **Donald J. O'Connor,** an assistant professor of civil engineering at Manhattan College and **Walter T. McPhee,** formerly with Malcolm Pirnie Engineers of New York City, are associates in the firm.

John K. Zimmerman is vice-president of the newly formed corporation, Pennsylvania Prestress, Inc., located at Camp Hill, Pa. The corporation manufactures structural precast and prestressed concrete beams, girders, roof panels, floor panels, and columns for bridges and buildings. Mr. Zimmerman was formerly bridge engineer for Gannett Fleming Corddry & Carpenter of Harrisburg, Pa.

William W. Hoy, partner in the civil engineering and land surveying firm of W. W. Hoy and John M. Hoy, announces the relocation of their offices at 844 North Birch Street, Santa Ana, Calif.

Harold A. Schaill has been appointed chief engineer of Northern Engineering Works, Detroit manufacturers of electric overhead traveling cranes. For the past ten years Mr. Schaill has been with the Whiting Corp., Harvey, Ill.

Hugh A. Powell and **Harry H. Hendon,** joint owners of the engineering firm of Polk, Powell and Hendon of Birmingham, Ala., announce that Mr. Hendon has acquired Mr. Powell's entire interest in the firm and that the business will be conducted under the firm name of Harry Hendon and Associates. **Afton B. Jowers,** senior member of the original engineering staff, is an associate in the new firm.

Earl O. Heaton, Captain, Division of Coastal Surveys, U. S. Coast and Geodetic Survey, has retired after nearly 38 years of commissioned service. He has been commanding officer of the *Lydonia* and *Westdahl,* and executive officer of the *Pioneer* and *Explorer,* and has done geodetic and hydrographic work in 27 states, Canada, Alaska, and the Hawaiian Islands.

R. H. McClurg, head of R. H. McClurg Associates, consulting engineers of Detroit, announces the relocation of the firm's offices at 12740 Fenkell Avenue, Detroit 27.

Charles W. Yoder, head of the firm of Charles W. Yoder & Associates, Consulting Engineers of Milwaukee, Wis., has announced the reorganization and expansion of the firm. **Paul E. Meves** has joined the firm as an associate in charge of the highways division and **Robert W. Watson** as associate in charge of the structures division. The partnership with **Ned E. Fischer** has been dissolved.

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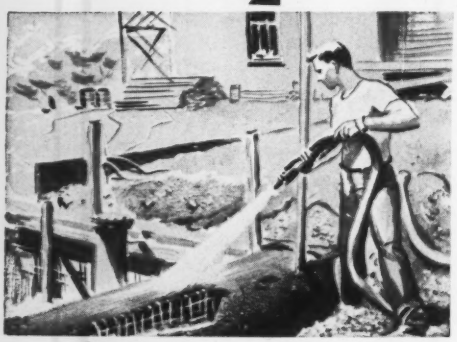

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Kenneth R. Young, area engineer for the Vicksburg District, Corps of Engineers, at Monroe, La., is retiring after more than forty years of service with the Corps. An expert on flood control, Mr. Young has spent his entire career battling the waters of the Ouachita and Mississippi rivers with construction of a wide variety of control structures.

Joseph Coel has established his own structural engineering office at 153 Homestead Ave., Hartford, Conn. Mr. Coel was formerly associated with Henry F. Ludorf, Hartford Architect, as structural engineer.

Edward D. Hubbard was recently appointed resident engineer of the Virginia State Highway Department at Waverly, Va. Mr. Hubbard has been with the Department for 33 years, and was resident engineer at Abingdon, Va., until recently.

Harold B. Gotaas, professor of sanitary engineering at the University of California, has been appointed dean of Northwestern Technological Institute effective next February 1.

Paul Andersen, professor of structural engineering at the University of Minnesota, is in Korea at present as adviser to Seoul National University. His address is c/o UNC Economic Coordinator, APO 301, San Francisco, Calif.

George R. Schneider, since 1942 chief of the Engineering Division, Little Rock District, Corps of Engineers, retired recently after nearly 25 years of government service. He is now an associate professor of engineering at the State University of Iowa. His assignments with the Corps of Engineers have included five years as chief of the Little Rock District's Design Branch. Mr. Schneider is a past-president of the Mid-South Section of ASCE.

G. R. Schneider

Charles D. McDaniel, Colonel, Corps of Engineers, formerly Executive Officer of the North Pacific Division at Portland, Ore., has reported to the Office of the Chief of Engineers in Washington, D. C., to assume his duties as new Inspector General of the Corps.

Charles A. Peters has been appointed assistant to the Commissioner of the Public Buildings Service of the General Service Administration in Washington, D. C. Mr. Peters has had 36 years of Federal service and has served the GSA as director of its Building Management Division since the agency was created in 1949.

Robert H. Bennett, specifications engineer of the Georgia State Highway Department, is on a six-month leave of absence from that department, to act as a consultant for the Commonwealth of Puerto Rico, Department of Public Works, Bureau of Highways. Mr. Bennett's assignment is the preparation of specifications for highways and bridges.

Remo Raviola has been with the staff of the Navy Department's R.O.I.C.C., Area 1 for six months as director of the Construction Contracts Administration Division on the Joint U. S. Military Mission for Spanish Bases. Before going to Spain in April, Mr. Raviola was assistant engineer of the Contracts and Specifications Division, Arizona State Highway Department. His address is R.O.I.C.C., Area 1, APO 285, New York, N. Y.

Conrad W. O'Connell retired early in September as general manager of the Onondaga County Water Authority, Syracuse, N. Y., and is now residing in Pasadena, Calif. Mr. O'Connell entered the employ of the New York Water Service Corp. in its New York City office in 1949, moving to Syracuse in 1950 as general manager of its Otisco Lake water system, which was recently taken over by the Onondaga County Water Authority.

(*Continued on page 28*)

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News of Engineers

(*Continued from page 27*)

Ben T. Collier, chief engineer of the Mississippi State Aid Road Building Program, Jackson, Miss., was recently named Chapter Honor Member of Chi Epsilon fraternity at the University of Mississippi. Mr. Collier is an authority in highway work, having served at various times as president and member of the board of directors of the County Division of the American Road Builders Association, member of the Board of County Consultants of the Bureau of Public Roads, and committee member of the Highway Research Board.

Clarence A. Callahan, former general manager, Dutton-Williams Bros., Ltd., Oakville, Ontario, has been appointed vice-president of the Majestic Contractors Ltd., Hamilton, Ontario. He will be in charge of the company's operations in the East with headquarters in Toronto. Mr. Callahan has been associated with Williams Brothers since his discharge from the Navy Civil Engineer Corps in 1946.

Virgil M. Capesius, former director of the San Diego Building Inspection Department, is now secretary-manager of the San Diego Lumberman's Association. The Association represents 43 lumber dealers in the San Diego metropolitan area. Mr. Capesius has been with the Building Inspection Department since 1953.

James A. McCarthy, professor of civil engineering at the University of Notre Dame, has been reappointed by Governor Craig of Indiana for a four-year term as a member of the State Board of Registration for Professional Engineers and Land Surveyors.

Earl L. Harrington, Walter E. Davy and **Louis A. Nees** have been appointed to new positions with the Air Material Command at Wright-Patterson Air Force Base, Ohio. Mr. Harrington is now deputy chief installations engineer, Walter E. Davy is deputy chief of the Facilities Support Division, and Louis A. Nees is deputy chief of the Construction Division.

Frank J. Buckley has withdrawn from the partnership of Andrews, Clark & Buckley, consulting engineers of New York City, and will practice consulting independently. The partnership will continue as Andrews & Clark, with offices at 305 East 63rd St., New York.

Alfred M. Freudenthal, professor of civil engineering at Columbia University, has been awarded the 1956 Medal of the Swedish Aeronautical Society. The presentation was made at the Swedish Institute in Stockholm. Dr. Freudenthal practiced engineering in Europe and the Near East for 26 years and in 1948 joined the Columbia faculty as a special lecturer.

A. Morgan Johnson and **Robert H. Zumstein** have resigned as associate professors of civil engineering at Wayne University to devote full time to their firm, Civil Engineers, Inc., located at 12800 Fenkell Avenue, Detroit, Mich. The firm does municipal engineering of all types and specializes in soils and foundations work. Both are continuing to serve Wayne State in the capacity of visiting professors.

Edward Wenk, Jr., has been named chairman of the Department of Engineering Mechanics of Southwest Research Institute. An authority in the fields of stress analysis, naval architecture, and building design and construction, Mr. Wenk was formerly head of the Structures Division of the David Taylor Model Basin in Washington, D. C.

Frank W. Edwards has been promoted to the position of associate in the Stanley Engineering Company, consulting engineers of Muscatine, Iowa. In his new position Mr. Edwards will continue his responsibilities as manager of the Chicago office and will also assist the partners in administering the activities of the company. He has been with the firm since 1953.

Eugene Reybold, Lieutenant General, U. S. Corps of Engineers (retired) and former Army Chief of Engineers, has been appointed special representative of the Jay Company, division of J. Leukart Machine Co., in Washington, D. C. He was formerly executive vice-president of the American Road Builders' Association and prior to that had served 38 years with the U. S. Army. General Reybold was Chief of Engineers through World War II.

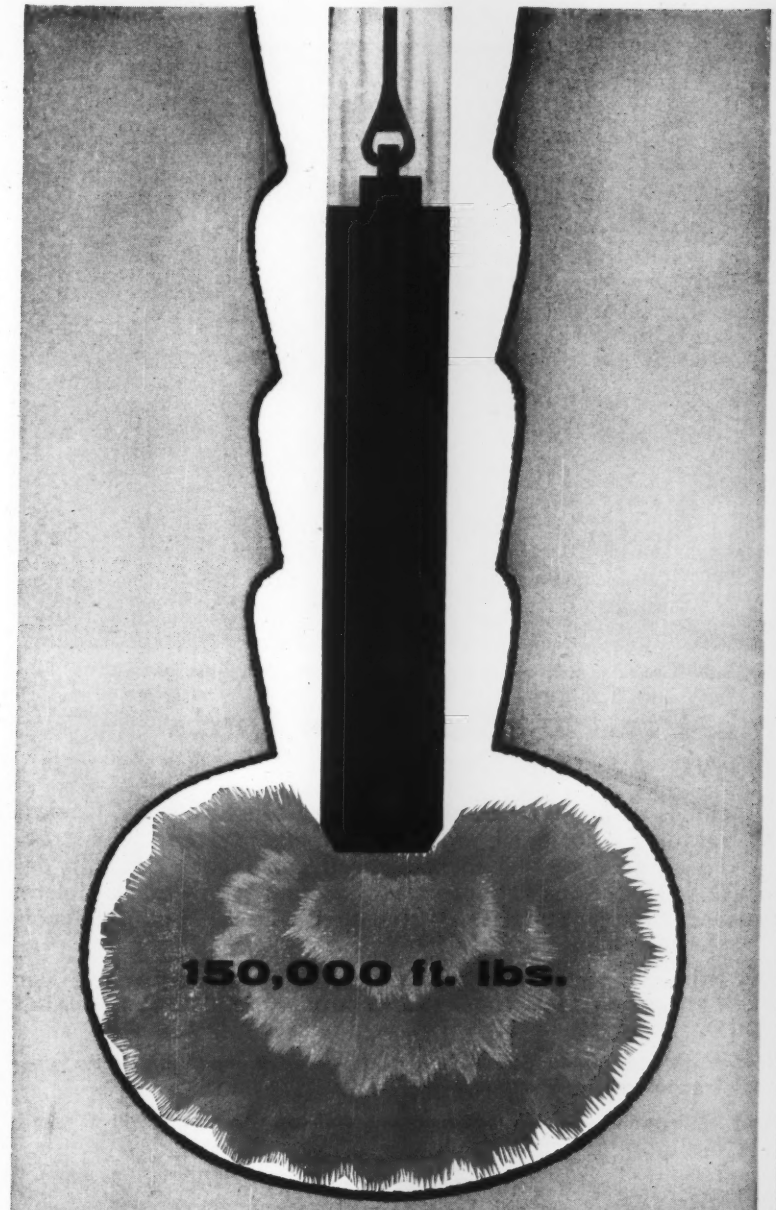
Eugene Reybold

Clarence J. Sikorski and **Roy J. Elam** recently formed a partnership to be known as the Charles Company, Professional and Civil Engineering Consultants, with offices at 958 Main Street, Paterson 3, N. J. Mr. Elam was formerly employed as an engineer in the Machinery Division of the Dravo Corporation of Pittsburgh, and Mr. Sikorski as a structural engineer with Robin Engineers, a division of Hewitt-Robins, Inc., of New York.

John D. Sykes, Jr., has joined the Furman University faculty at Greensville, S. C., as assistant professor of engineering. Mr. Sykes has been a district sales engineer with the Granco Steel Products Co. of Atlanta since 1950.

Anthony J. Costanza, structural engineer, announces the opening of offices at 6515 Crescent Blvd., Pennsauken 5, N. J.

(*Continued on page 92*)



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Once again the Nabisco Engineers chose a Franki Foundation and awarded the contract to us for the Laboratory Building. A total of 130 standard Displacement Caissons or Pressure Injected Footings were installed. The expanded bases were formed in a suitable sandy strata at depths varying from 15 feet to 30 feet below the surface. The maximum design load per caisson is 120 tons.

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The Engineering Department of National Biscuit Company prepared the building design and Walter Kidde Constructors, Inc., is the General Contractor for the Laboratory Building.

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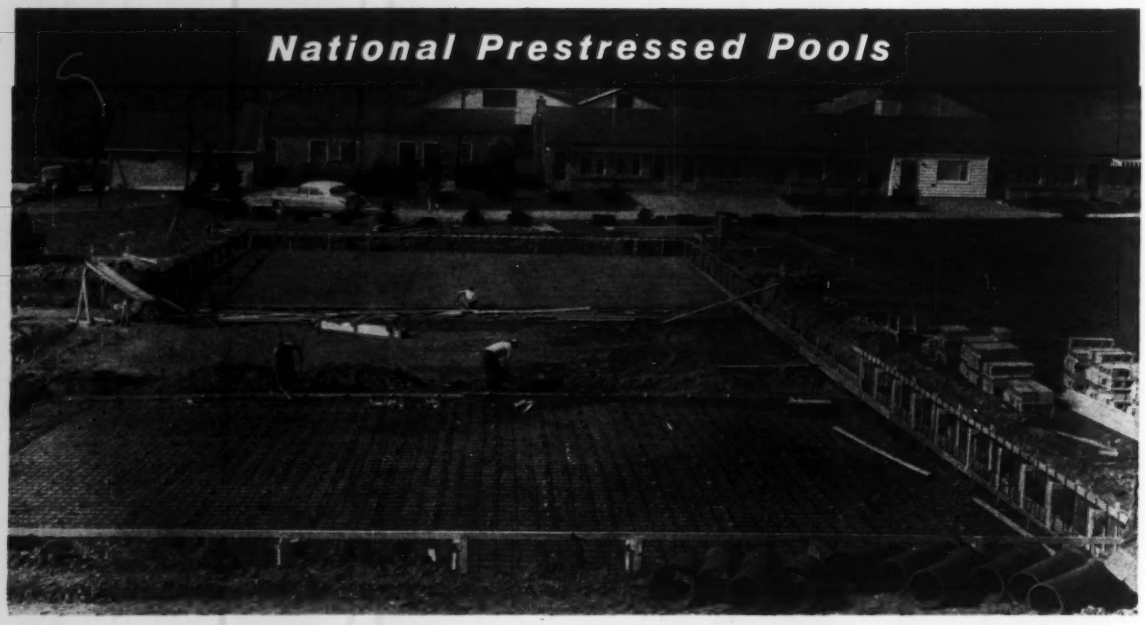

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The Annual Convention in Pittsburgh was tops? This is the consensus of engineers returning from Pittsburgh—the second city outside New York to entertain an Annual Convention in the past seventy-five years. The Convention story is on page 64.

Some of the problems vexing members at Local Section level are discussed here? The theme of our new President's inaugural address, delivered at Pittsburgh, was his recent questionnaire directed to all Local Section officers. President Lockwood's stimulating address leads off the issue.

A pilot survey of the civil engineering profession will be made by the ASCE Task Committee on Engineering Education? The Board of Direction has approved an appropriation to carry out this important survey, which was presented initially at the St. Louis Convention in 1955. The agenda of Board actions at Pittsburgh is briefed in the "Society News" section.

Questions about the new ASCE Catastrophe coverage are answered here? In case you want to know more about the additional insurance benefits provided in the new Catastrophe coverage, the administrators of the Society's insurance plans answer eighteen of the questions most frequently brought up (page 73).

This is primarily a highway issue? With the national road program foremost in engineers' minds, this issue is devoted to articles (many of them from the Pittsburgh Convention) on different phases of highway planning. Of major interest, too, is the long-awaited appointment of a Federal Highway Administrator—ASCE Member Bertram D. Tallamy, the well known chairman of the New York State Thruway Authority (page 84).

A start has been made on the Federal Highway Program? Though individual projects have been approved in more than a dozen states, first dirt is flying on an expressway job in St. Charles County, Missouri, the first state actually to institute a project under the new highway act.

More miles of turnpike are being opened to traffic? Not a month goes by without its quota of new turnpikes. The 236-mile Kansas Turnpike, streaking across the prairie from Kansas City to the Oklahoma border south of Wichita, was dedicated on October 25. Built at a cost of $160,000,000, the new toll road is the largest private financial venture in the history of the state. In September it was the 140-mile east-west Indiana Turnpike, of which the final 16-mile link to Chicago will be opened sometime in November. Opening of the Miami-to-Fort Pierce section of Florida's Sunshine State Parkway is scheduled for January.

Our motor vehicle registration continues to gain? A year ago there were 61,300,000 registered motor vehicles in the United States, and by the end of this year the expected total will be 65,275,000. Still more startling is the forecast of 81,000,000 registrations by 1965. Leading states in this year's increase are Florida, Arizona, and Nevada. Forecast and figures are from the Bureau of Public Roads.

Traffic accidents claimed 10,946 victims over the summer months? This was an increase of 9.4 percent over the total for the same months in 1955. On the other side of the ledger, the National Conference of State Safety Coordinators reports, traffic deaths during all three major summer holidays were below those of last year. There were no serious accidents on the Ohio Turnpike from midnight the Wednesday before Labor Day through midnight of Labor Day, though 272,092 vehicles moved over the superhighway during the period.

There is a new device for measuring runway roughness? Improved safety, economy, and riding comfort in airplanes, motor vehicles, and trains will be ultimate results of a runway roughness measurement device developed for the Air Force by the Midwest Research Institute. Airplanes, we are reminded, face one of their toughest structural tests, not in the air, but when they taxi onto a runway for takeoff.

The AASHO will soon begin its third and largest road test? More than 200 pieces of road-building equipment are hard at work on a site near Ottawa, Ill., where they are constructing four 7,600-ft test loops and other facilities for the test, which will be the largest ever conducted. There will be an article in the December issue, by Fred Burggraf and W. B. McKendrick, Jr., describing the essential objectives of the $14,000,000 undertaking.

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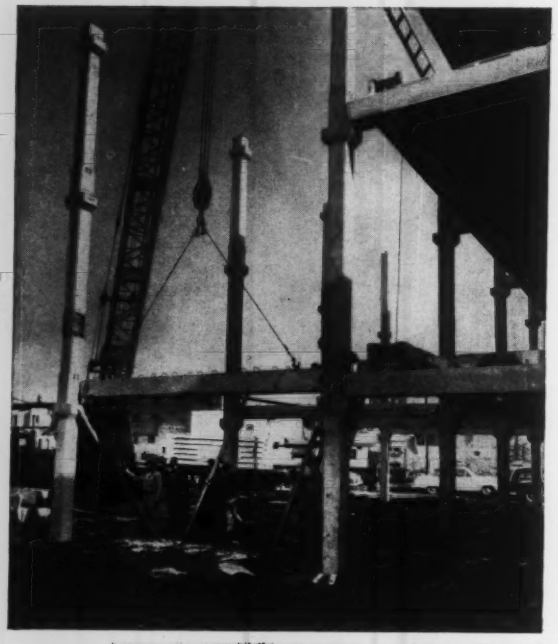

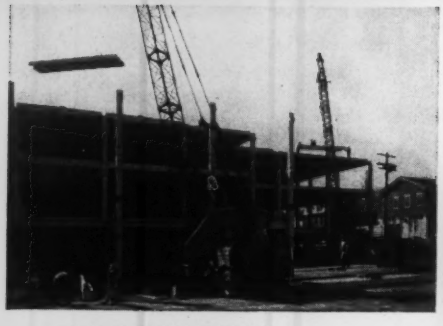

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● Winter often slows concrete work, but on this concrete building in Bridgeton, N. J., columns, beams and floor members were factory precast and shipped to the site from 30 miles away. As a result, 66 precast bays went up in 11 days on this new 120 by 220-ft. industrial building in Bridgeton, N. J.

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The prestressed beam soffits form the bottom half of the web of a composite T-beam, completed when the topping was placed. Beam soffits were prestressed to carry both the dead load of the channels plus that of the topping. Prestressing was accomplished by tensioning sixteen ⅜-in. strands.

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CIVIL ENGINEERING

President's Inaugural Address at Annual Convention of ASCE, Pittsburgh, Pa.

MASON G. LOCKWOOD, President of ASCE

Partner, Lockwood, Andrews & Newman, Consulting Engineers

Houston, Tex.

Forty thousand heads are better than one

"General supervision over the affairs of the Society," has been constitutionally delegated to the President of the American Society of Civil Engineers. What an awesome, humbling responsibility for one ordinary engineer, especially one whose vainest thoughts can never dispel the haunting realities of a necessarily imperfect system of presidential selection! This system—as logical, practical, and truly democratic as more than a century of trial and error has been able to make it—is utterly unable, of course, to bring about the selection, from among the nearly forty thousand civil engineers of our Society, in this country and elsewhere, of the one engineer best able to head the Society for a particular year.

On the whole, though, this unidealistic process has in the past been astonishingly successful. Certainly no organization in America has produced more brilliant, unselfish, and dedicated leaders for the engineering profession than has the American Society of Civil Engineers in its 104 years of rich and useful history.

For a long time the membership was concentrated largely in the New York area and in the northeastern part of the country. This is reflected in the list of the home states of the presidents before about 1900. As the membership became more truly a national one, shifting more to the west and south, and as transportation and communication have improved, the titular head of the Society with increasing frequency was chosen from these more recently developed areas.

From James Laurie in 1852 to Enoch Needles in 1956, 87 presidents have served the Society. But 26 states—some indeed quite populous with civil engineers, and comprising some 62 percent of the area of the United States—have furnished none of these presidents. The magnanimity of the electorate, in permitting Texas to break through this year, reduced to 25 these "presidentless" states, and cut back the unrepresented area to 53 percent. Doubtless it will be said—and with some measure of logic—that anything might happen now.

The very wholesome geographical distribution of the presidency during recent years has been the result of the system of rotation between the four geographical Zones of the Society. This system has been practiced voluntarily by the Board of Direction in making its nominations. To varying extents, rotation within Zones is practiced by the Local Sections.

Fair as this method is, and well as it has worked, the rotation system is inherently somewhat dangerous. Carried to its "illogical" conclusion and practiced without restraint, the Nominating Committee of the Board might some day find itself under strong pressure of precedent to nominate a man from a very limited area, regardless of the comparative qualifications of the eligible prospects in the particular area and in the country as a whole.

No past Nominating Committee has placed, and I am confident no future Nominating Committee will place, the precedent of rotation above all else. But if it did, the membership probably would, and rightly should, rebel. Thus it behooves the membership to keep itself informed and to remember always that this is their problem too and their responsibility, and that in the use and administration of the rotation system a hard choice someday might have to be made between professional statesmanship and personal geography.

The President is the titular head of the Society, but the Board of Direction in truth and in fact runs the Society. It runs the Society to suit the rank-and-file members or not to suit them, depending on how articulate these individual members are and how effective is the two-way communication between them and the Board.

The deeply rooted, time-tested and proved technical and professional strength of our Society is well known, thoroughly documented, and widely acclaimed, especially in engineering circles. The unwavering public regard for the Society, on the one hand, and the consistent warm loyalty and devotion of its members on the other, are eloquent testimony that principle and not expediency has prevailed in a century of evolutionary processes.

It is our responsibility, it seems to me, not to be content to rest on the shoulders of those who have preceded us; not to bask idly in our glory but to continue to examine our Society, indeed, to look to our weaknesses—to the soft spots in our structure—rather than to our strengths, as a means of increasing and consolidating these strengths. To do this, I realize, is to deal with negatives rather than positives.

Imperfect sensitiveness to the hopes and desires of the constituency characterizes any democracy, including our Society. That is a penalty of freedom. Factors which sometimes contribute to this democratic defect—in addition to the two already mentioned, inarticulateness and poor communication—are the ponderous but usually necessary organizational restraints, stratification, loss of the common touch, blind reaction, and that always redoubtable enemy of progress, inertia. When these measures of weakness are applied to the Society by a loyal and thoughtful member, he may feel some personal dissatisfaction and discontent. Unless his loyalty completely prejudices his judgment, he is likely to conclude that the plain truth is, we could do better.

In the melancholy mood which this truth induces in a buoyant member, I set about to plan—as a new President is expected to plan—some kind of appropriately constructive program for my brief tenure, brief as measured by the very long history of our organization. Ideally, I should have liked to seek and secure in writing, the privileged, thoughtful, and uninhibited recommendations of each of our nearly forty thousand members. How much better that would have been than a plan from one head! But I was obliged to content myself with addressing a personal appeal for assistance to the president and secretary of each of our 74 Local Sections. In these letters I implied that any immediate past president could develop a sound program for the ensuing year and outline it in an inaugural address but that it did not, of course, work that way. The incoming President must do this, and without benefit of the year's intensive grassroots association and counsel he so desperately needs to qualify him.

From this point of departure I asked each of these current local regional leaders only two simply stated questions about the Society:

1. What are our principal weaknesses?
2. What remedial measures would you suggest?

The response has been rather overwhelming in the sense that I have been unable in the time available to assimilate and organize the substance of these candid views sufficiently to permit full reporting here.

I am truly delighted, of course, with the avalanche of ideas and wealth of informed grass-roots opinion which was sent to me when it was understood that I earnestly sought to increase my grasp of the situation. But I must confess that I am still a bit overawed by the challenge that was triggered by my letters of inquiry.

It is not, as might be expected, an excessive diversity of opinion from my respondents which has stalled me for the moment, although there certainly is diversity. Rather it is the frequently far-reaching nature of the ideas and suggestions, and how those which have not already been seriously examined can best be tested and implemented. Many of the weaknesses cited are already being worked on assiduously and with good promise of improvement.

It will be understood, I trust, that I would not, in my new and official capacity, have the effrontery to endorse or advocate, to any extent, any of the suggestions with far-reaching implications without their having first withstood the rigorous examination afforded by our very effective committee and Board procedures.

At the same time, though, I should like it to be understood that I do pledge to all these respondents to whom I shall ever be indebted, and to the individual members they represent, that it is my purpose to bring about through regularly constituted procedures the refinement and ultimate adoption of those of their suggestions which unprejudiced consideration proves to be feasible, meritorious, in the public interest, and for the greatest good of the greatest number of our profession. I am too recently of the rank and file to be unmoved by its composite wishes—if I can only know what they are. Our Presidents serve, as you know, only for one year. Thus I trust that I will not fall victim to that insidious occupational hazard which sometimes leaves the leader of an organization believing that the rank-and-file majority really is incapable, for one reason or another, of knowing what is good for it.

As I have indicated, I cannot now report in full on the results of my sampling of membership opinion on Society affairs. Although not regarding it as a scientific sample, I treasure these local expressions immeasurably and consider them of unusual significance. I will now generalize on some of the expressed sentiments.

There were 80 specific replies to my letters of inquiry relating to Society weaknesses, aggregating some 145 pages of considered, non-capricious advice. Many presidents and secretaries of Sections collaborated and submitted their views together in a single letter. In some Sections the membership discussed the questions in meetings before their officers replied. Sixty Sections with about 90 percent of the membership are represented. I also received numerous letters directly from members who at present are not Section officers. Curiously, all the Sections west of the Mississippi River, including the Hawaii and Alaska Section, were heard from. Curiously, too, five of the total of 14 Sections from which no report was received are contiguous and situated in the northeastern part of the United States.

In casting about for a means of interpreting the replies, I found that all the alleged imperfections discussed in the 145 pages could be grouped under eight subject headings, including one inevitable miscellaneous category. In the order of prevalence, these are:

1. *Problems affecting Junior or younger Members*

This subject was dealt with to some extent by about 45 percent of the respondents. Clearly there is widespread dissatisfaction with the Junior Member classification. The strongest agitation for elimination of this classification—or degrading classification as some call it—

appears to come from those in the Associate and Member grades rather than from the Junior Members themselves. Doubtless, though, a change in classification designation would be welcomed also by the Junior Members.

While many other aspects of the Junior Member and young engineer problem are covered, most, in one way or another, concern the Society's substantial loss of Junior Members each year. Some way is wanted for the certain and automatic transfer of graduating student engineers into the Society and for keeping them there as long as they are practicing members of the profession. The so-called "up or out" rule of the Society for upgrading Junior Members professionally is in distinct disfavor in some quarters.

These, of course, are by no means new problems which have escaped previous notice.

Past President Roy Glidden recently said, "What to do in regard to a suitable appellation for our younger members, rather than 'Junior,' is a vexing question which has plagued us for generations." He also expresses a widely held view, I believe, when he further states, "I do not like the term 'Junior' and what it connotes and, on the other hand, I do feel that tradition and prestige demand differentiation between full Members and Associates."

On the question of the loss of Junior Members, my only personal concern is for those who may have dropped out because the Society has failed to make them understand its significance. A Junior Member who truly understands this significance, expects to remain in the profession, and drops his membership, probably is no credit to the profession and hence no loss to the Society.

2. *Ineffective action for professional and economic betterment*

About 37 percent discussed some aspect of this alleged weakness.

Rather large numbers of our members consider aspirations for economic betterment not altogether incompatible with professionalism for engineers. They seem to believe that this will come as a shock to some of us.

There is great concern, which I share, over the inadequate compensation received by that vast body of engineers and engineering educators with from five to fifteen years of experience, whose income has not kept pace with the world around them. This group is being seriously squeezed because their income has not kept pace with the mounting cost of living. And matters promise to get worse before they get better. The cost-of-living index, after a three-year level period, has turned up sharply enough to give its graph the appearance of an east-bound snow ski.

There is no dissatisfaction with the level of starting salaries of young engineers, except that this frequently highlights the squeeze further up the line. In fact, the pressure resulting from such high starting salaries is a favorable influence, which hastens the correction of equities in present engineering salaries and income.

There is concern, which, again, I personally share, over the adverse professional effects on some young engineers of the increasingly irresponsible "bidding" practices for the services of young engineers during the present critical shortage at a time of highest national prosperity.

And definitely, a great many of our people are quite willing, if necessary, to sacrifice our Society's present tax-exempt status to secure the latitude needed for more effective efforts toward professional and economic betterment. This probably is an area of much misunderstanding, particularly in reference to the Society's ability to engage in limited legislative activities. Former Executive Secretary William N. Carey, who has made careful study of the subject, said to me recently that, "Retention of our 'tax exempt' status does not 'restrain' ASCE in the least from doing anything I can conceive that any ASCE Board would or could do on legislative matters concerning the profession."

The really significant thing about the whole subject of more positive action for professional and economic betterment is that one of the Society's strongest Task Committees, now called the "Committee on Economic Advancement," was constituted by the Board within the past year and directed to make a positive and comprehensive exploration of the subject. That this committee is not widely known to the membership is understandable. While the creation of this committee was publicized, its conclusions and recommendations have not yet crystallized.

3. *Unsatisfactory communication and public relations*

Some 37 percent were disturbed by this, which they recited as a weakness. Many feel that the Society actually is doing much more for its members than the members realize and that this situation is due to faulty communication and deficient public relations.

The paradox of a good medium of Society news in CIVIL ENGINEERING and a completely literate but inadequately informed membership prompts Past President Walter L. Huber to recall the recent remark of Alfred Knopf, the publisher. Mr. Knopf said, "I am not so interested in 'why Johnnie can't read' as I am in 'why Johnnie's parents won't read.' "

The Society cannot make its members read about these things in CIVIL ENGINEERING, but it might recognize the situation, some believe, and try to get single-shot messages across by means of brief, periodic letters to the individual members dealing with only one or two matters at a time.

As many of you know, the Society has been using the services of a public relations consultant for several years. Press and broadcasting activities at Society Headquarters have achieved substantial results. These have been augmented in many areas by the cooperative efforts of Local Sections. The desired results will be attained even more widely and more frequently as additional Local Sections also engage in public relations activities.

The plea for improved public relations is generally directed toward the elimination of some of the major weaknesses reported in other categories, such as the need for enhancement of the profession through better recognition, improved economic status, community prestige and improved public understanding and appreciation of the contribution of civil engineers.

This again is no new problem, nor one not already receiving much attention calculated to improve conditions. For example, there is the "Annual Report for 1956," released during the Annual Convention in its exciting and imaginative new format. There are innovations in news coverage to improve communication. Especially important is a broader, systematized program of visits by staff members to Local Sections. I am told that 25 or 30 percent of the Sections haven't been visited by the staff in the past three to five years and that, in some instances, the time since the last visit has been seven or eight years.

4. *A predominately apathetic membership*

Personal and individual apathy and lack of enthusiasm were cited by about 34 percent as thwarting the potential of the Society. Some members, for a variety of reasons, get the feeling of being left out and soon begin to leave themselves out by withdrawing, avoiding Society activities and their responsibilities to the profession. They may pay their dues cheerfully and read the technical publications avidly, but they contribute practically nothing more.

The remedy most often suggested involves some form of stimulation at the local level, under the theory that many of the restraints contributing to the lack of enthusiasm are more imaginary than real. These men are urgently

needed at all levels of Society activity, but simply have not been sufficiently stimulated to respond to this challenge.

A staff study made some time ago would indicate that only about 15 percent of our membership really is active. This situation is being attacked through improved communications in the belief that only an informed member is an interested member.

5. *Insufficient contact between local and national levels*

Thirty-one percent, or thereabouts, thought there is too little contact between our national and sectional or regional levels. The suggestions are for more local appearances of national officers and especially of staff members. The present, but relatively new, practice of holding meetings of the Executive Committee of the Board at various places throughout the country in conjunction with regional meetings, is endorsed by the writers as an instrument of improved contact.

6. *Lack of positive action for professional unity*

Surprisingly, only 21 percent seemed dissatisfied with the Society's efforts for professional unity—surprisingly, that is, because of the tremendous interest in the subject throughout the profession. Yet this does mean that about a fifth of these leaders of ours think we can and should do better in this respect. Had I written one of these replies, I would have complained of the relatively slow progress in this movement. Our part in the deficiency, I would have attributed to a languishing and somewhat overly selfish interest in our own Society at a time when the very highest order of professional statesmanship by all engineering societies and their respective memberships is so clearly essential.

The fact is, however, that ASCE is and consistently has been a stalwart unit of Engineers Joint Council and, through that medium, is trying its best to overcome the generally deplored inadequacies in the field of professional unity.

7. *An over-centralized organizational set-up*

Inevitably, some think that our national organization is overcentralized and too autocratic. Fifteen percent of my respondents spoke of that in one way or another—and with varying degrees of restraint. One complains of the "lofty national attitude." Another bitterly likens the national set-up to "an exclusive club with a New York accent." That colorful complaint is not now valid—although it probably once was justified. In any event, the slurred accent of your new President should tend to dilute for one year whatever is left of the New York accent. And doubtless his accent, if any, will be criticized for more valid reasons.

8. *Other weaknesses cited*

As I said earlier, the miscellaneous or random weaknesses discussed by the various respondents can only be grouped in the inevitable "miscellaneous" category. Numerically, there were about 60 of these unclassified and alleged defects.

One man, for example, thought the Board of Direction overworks itself unnecessarily. He said: "Why not establish policy and procedure in the Board and delegate as much of this detail as possible away from these few hard-working men? After all, the Society is made up of grown and responsible men. Why not use them?"

Another loosed a mild blast at the Society because it fails to measure up to his concept of its responsibility in aiding young graduates to adjust to the professional business world. To quote him: ". . . the Society doesn't do much to help the young college graduate become adjusted to the professional business world."

With this I come to the end of my detailed interpretation of these letters which have comprised the material for this address.

I would not dare end this discussion, however, without reminding you that my respondents, by invitation, dealt exclusively and deliberately with situations which they or the members they represent believe constitute flaws in our structure. Thus little has been said about sources of our strength. This Society has not reached its present place of unsurpassed eminence in the engineering profession of the world because of its weaknesses, but rather because of its century of overriding virtues, and in spite of its transitory imperfections.

The leaders who have written to me of its deficiencies, have been generally silent, except for praise, on the subject of technical activities, publications and general administration. Under the circumstances, this silence speaks volumes about our strengths in these older fields of Society endeavor. Indeed, one can almost imagine a purring contentment from the general satisfaction with the Society's achievements in these fields.

Many of my respondents, understandably, were unable to deal exclusively with our deficiencies. They wanted to, and did, discuss enthusiastically many features and numerous accomplishments which all agree are unparalleled in their excellence.

One highly regarded president of an influential Section—but only one, I am happy to report—politely took me to task for my preoccupation with weaknesses. My inquiry letter represented, he said, "a negative approach" inasmuch as "the ASCE is a paragon among societies, professional groups, or any way you wish to compare it." I admire the author of that letter for his unique and forthright point of view, for having lodged his objection, he proceeded to submit precisely what I had requested, and in a truly competent, beneficial way.

I submitted a preliminary draft of these remarks to, and invited the frank comments of, five of our very prominent members, each with a rich background of Society activity, from four different Zones of the country. Their reaction to my polling of the Sections on Society weaknesses was as bewildering as their comments were helpful. Two considered the results highly significant, one quite significant, and the other two considered the results of very little significance.

To that, I can only say, as I indicated earlier, that this crude polling device represents my best effort to prepare myself for a Society task. The information received will be most helpful to me. That the procedures employed are unorthodox is therefore of little consequence. One man whose only problem was he could never remember which hand was his right and which his left, solved this to his satisfaction by simply remembering that his right hand was the one with the thumb on the left.

To the extent, though, that my approach has been negative, I hope you will remember that I have explored the negative solely in looking to its elimination. We have seen that many of these very things about which the Section presidents and secretaries complain are already being worked on assiduously and I believe, effectively. Certain of the indictments are not valid at all. This emphasizes one of the oftencited defects, the one about the inadequacy of our communications. It also recalls the astute saying of Abraham Lincoln, "A universal feeling, whether well or ill founded, cannot be safely disregarded."

Finally, in answer to the perfectly obvious question as to what I expect to do about all this, I expect to seek the authority and the cooperation of the Board of Direction in making available, at least to the Board and the Section officers, the contents of these thought-provoking letters. Promptly I expect to have placed in the hands of the appropriate committees, a statement of the weaknesses enumerated and the remedies proposed. My aim, I assure you, is neither to bury nor to praise the recommendations, but rather to implement the worthy and feasible ones.

Multi-billion-dollar federal-aid highway program takes shape

C. D. CURTISS, M. ASCE, Commissioner of Public Roads, Washington, D.C.

It was in July 1954, that President Eisenhower sent a message to the Governors' Conference calling for "a grand plan for a properly articulated highway system that solves the problem of speedy, safe continental travel—intercity transportation, access highways, farm-to-market movement, metropolitan-area congestion, bottlenecks, and parking."

Two years later the Federal-Aid Highway Act of 1956 became law. This interval was filled with intense and fruitful activity by highway officials and engineers, by the Commerce Department's Bureau of Public Roads, and by many groups interested in highway transport. Both houses of Congress studied the problem exhaustively.

This careful and conscientious approach is reflected in the legislation itself. The 1956 Act set the stage for the greatest road building and highway improvement program in all history. Now under way, the huge 13- to 15-year program for the National System of Interstate and Defense Highways will provide a 41,000-mile network of modern roads and expressways connecting the 48 states and linking 209 cities of more than 50,000 population.

Inevitably this law marks a new era in highway engineering. It also opens much broader vistas to civil engineers.

The bill authorizes $24.8 billion of federal funds for the Interstate system. This amount, plus some $2.6 billion contributed by the states, will be used to construct a coast-to-coast system designed to provide for 1975 traffic volumes. In that year more than 90 million vehicles are anticipated. Traffic will flow into and around large cities over safe, divided highways of four to eight lanes, protected by carefully planned access. Only about 7,000 lightly traveled miles of this system will be two-lane roads, and the basic design and right-of-way requirements of these sections must allow for additional divided lanes as traffic increases.

The magnitude of this undertaking, which for the first time envisages the completion of an entire nation-wide highway system built to high standards, is self-evident. Its implications for many segments of the engineering profession are far-reaching indeed. Design problems alone will call for a new measure of vision and technical skill.

In looking at this aspect of the new program, we should remember that all told nearly 755,000 miles of road systems are eligible for federal aid. The 1956 Act made increased provision for all of these systems.

Undoubtedly, this legislation presents highway officials, highway engineers, and the Bureau of Public Roads with the greatest challenge they have ever faced. We shall not be operating in a vacuum however. The general plan of operation will continue a long-established policy of cooperation between the states and the Federal Government.

Federal aid as we have come to know it began in 1916 when Congress enacted the Federal-Aid Road Act, which laid the foundation for the cooperative federal-state highway program in existence today. This time-tested pattern, strengthened and improved over the years, has become an outstanding example of sound federal-state relations.

Under that program, and still continuing, federal grants are apportioned according to formulas, which give weight to the relative area, population, and rural mail-route mileage in each state. These federal grants for highway construction must be matched by the states with their own money. The states have retained the initiative and prerogative in selecting roads to be improved and the type of improvement. They are responsible for surveys, plans and specifications, for letting contracts, and for supervision of construction, subject to approval by the Bureau of Public Roads. Maintenance of the roads built with federal aid is an obligation of the states. The Bureau will continue to carry out a wide range of engineering, administrative, and research activities designed to help the states in planning and developing a safe, efficient system of interconnected highways.

Five specific studies by BPR

Under the provisions of the 1956 Act, the Bureau with the help of the states and other agencies is called upon to carry out five major studies. Any one of these studies would be a substantial undertaking of itself. Taken together, they will impose a major responsibility on both the Bureau and the states. Most of the work in the states will fall on the highway planning divisions, including engineers.

Taking the studies as they appear in the Act, we come first to the section which calls for estimating the cost of completing the Interstate system. This must be submitted to Congress by January 1958. The results are expected to provide the basis for apportionment of funds for the fiscal years 1960–1962.

Reestimates are then required at intervals through 1968.

Next comes the study to determine the maximum desirable weights of vehicles. While the forthcoming road test of the American Association of State Highway Officials in Illinois will be of much help, a great deal of additional information will be needed to determine what pavement structures will be required and the magnitudes and frequencies of axle loads to be expected on all the federal-aid systems.

The third study required, is to aid Congress in determining a policy with respect to reimbursement for highways, whether toll or free, constructed between 1947 and 1957 that are included in the Interstate system. This will involve a determination of the roads that "measure up" to the standards and a study of all factors of "cost, depreciation, participation of federal funds, and any other items relevant thereto."

The fourth study will deal with highway safety. Two items the Bureau definitely hopes to include are a pilot study of the real causes of highway accidents, and a study of the effect of speed and horsepower on accident causation. In starting this study, we are fortunate in having a comprehensive analysis of accident costs nearly completed in Massachusetts, and prospects of similar studies in the western region.

The fifth and most difficult undertaking is what we call the "incremental study." This calls for an analysis of the cost of providing highway facilities for different classes of vehicles, and of the benefits derived from highway use by all classes of highway users. These figures must be determined for all federal-aid systems. In addition, the Bureau is required to estimate the benefits of highways to other than highway users. The purpose is to provide Congress with a basis for determining "equitable" rates of taxation on highway users and other beneficiaries. This study is the most formidable ever presented to the Bureau's Research Division. By influencing federal taxation, the findings could have a profound effect on future highway transportation.

Basic design criteria

Design features adopted for the Interstate system, together with intricate problems posed by many urban structures, will enlist the best efforts of highway engineers throughout the country.

The design speed is to be at least 70, 60, and 50 mph for flat, rolling, and mountainous topography, respectively, and 50 mph in urban areas. This is not a forecast of travel at such speeds. The figures indicate a wide margin of safety in design.

Traffic lanes are to be at least 12 ft wide, shoulders 10 ft, and medians 36 ft wide in rural areas. The roadway will not be narrowed at a bridge unless the bridge is very long. Clearances at underpasses are to be at least 8 ft on the right and $4^1/_2$ ft on the left, with the commonly used minimum vertical clearance of 14 ft.

Perhaps the most important standards are those which deal with access and intersections. Access control is mandatory on all Interstate highways; railroad grade crossings are forbidden; and, except for lightly traveled two-lane roads, there will be no highway crossings at grade.

Concerning engineering manpower

As the 1956 Act took shape, it became obvious that such an accelerated program would impose tremendous demands on highway engineering manpower—quite apart from the special technical skills required.

For months the Bureau of Public Roads, the state highway departments, and other interested groups, have focused attention on ways to expedite the new program and make the optimum use of available engineering personnel. Here are a few of the steps being taken.

In order to help realize the full potential of highway contractors, highway engineers are stressing long-range construction planning. States are preadvertising highway work schedules, and contract awards are being made earlier so that contractors can place orders for materials in limited supply. Engineers are also planning the letting of longer projects.

Knowing how essential the advance acquisition of rights-of-way may be, highway engineers are very much interested in the revolving-funds plan, first developed by California.

State highway departments are moving on a variety of fronts. Some standard plans have been developed for drainage structures and small bridges by nearly 80 percent of the states, and for bridge structures by more than 70 percent.

Aerial photography is now in wide use by highway engineers; 46 states have indicated that they are using it in varying degrees. The principal use has been in highway location, but several other time-saving uses have been reported.

Nearly a year ago the Bureau of Public Roads assigned engineers to develop the application of high-speed electronic computers to highway engineering operations. They have been consulting with industrial firms that use these machines to learn what applications have been and can be made of these devices. Conferences have also been held with manufacturers. Here is a partial list of the more important areas in which high-speed electronic computers can increase appreciably the productivity of engineers and supporting personnel:

1. **Traffic and planning**
2. **Correlating accident rate with types of signs and signals**
3. **Determining the flow of water from a given drainage area**
4. **Bridge design**
5. **Computing earth quantities in highway location and design**
6. **Computing earth quantities, particularly earthwork in final estimates**
7. **Route and cadastral surveys**

Methods of using electronic computers have already been developed and successfully applied to the regulation of traffic flow. The Bureau has developed formulas for programming cross-section data into electronic computers thus making it possible to compute earthwork quantities without cross-section sheets and at great speed—30 times faster than by the old manual method.

Widespread pooling of experience with new methods is being expedited by state highway officials, the Bureau of Public Roads, and other federal agencies. Meetings in Chicago, Ill., Albany, N.Y., and Atlanta, Ga., have explored further avenues of approach, among them the combined use of electronic computation and photogrammetry in highway location and construction practices. Further meetings undoubtedly will reveal additional time-saving techniques.

The Bureau of Public Roads and several state highway departments are interested in developing a library of electronic computer programs which can be made available for highway engineering in all states. Such programs will be convertible to machines made by any manufacturer.

The Engineering Division of the Bureau of Public Roads is now making field tests for a manual to be used in estimating the cost of constructing the Interstate system in a 13-year period. Under the new manual, it will be necessary to make more accurate determinations of the location of the Interstate system. Once such determinations are made, they will set in motion a series of actions which should permit extensive conservation of engineering effort. For example, through advance acquisition of right-of-way on a known location, design engineering operations can be undertaken utilizing mass production techniques, and the orderly removal of buildings and other obstructions from the right-of-way can proceed.

All in all, the Highway Act of 1956 has opened not one but many doors to civil engineers. Judging by past performance, the profession will be alert to every opportunity.

THE PROBLEM OF CONSTRUCTION PLANS AND SPECIFICATIONS

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As every engineer connected with or interested in the highway situation is aware, we are faced today with a problem in the preparation of construction plans and specifications of an immensity only dreamed of a few years ago. The public has been deluged with publicity on the new Interstate System, with its promise of a rosy future for the motorist. Much has been written about the impact of the huge construction program on our economy, the materials and equipment to be purchased, and the number of men to be employed, but practically nothing has been said about the plans that will be required before the program can be carried out. Moreover, few writers seem to realize that work on the present system must continue, and in fact increase,

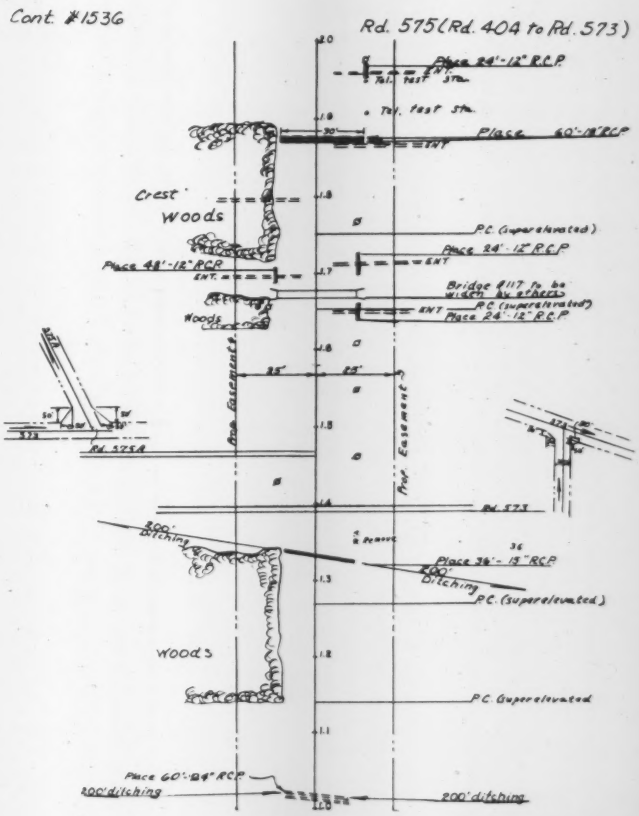


FIG. 1. Typical survey sheet for a secondary road construction project in Delaware was made by a group, consisting of one soils man, one design man, one drainage man, and the chief inspector, riding in a car equipped with an odometer. Specifications allow 2 ft of deviation in either direction from centerline and 6 in. in either direction from existing grade. Plans are applicable only in initial stage of converting dirt road to surface-treated road. Photo shows typical stretch of secondary road built from these plans.

as the new Interstate System influences and changes the traffic pattern.

Of course highway engineers charged with the problems of their particular states are well aware that plans are the primary consideration in both the construction of the Interstate System and the rebuilding of the present system, and they are working overtime trying to develop methods of saving time and manpower in preparing them. Changes in highway engineering planning and design are being forced by our highway traffic problems, lack of competent highway engineers, and the Federal Highway Bill, with its stipulation that certain work be done within certain specified time limits. A way must be found to abridge plans and specifications and to shorten the time now required to produce them. Most of the thinking on the highway program has been directed toward the introduction of machines, such as electronic computers for earthwork and grade, typing and other equipment to eliminate hand lettering, and new construction machinery. Too little thought, I believe, has been given to the actual preparation of the plans and specifications.

During the past several years in the consulting field I have had an opportunity to work with several different states, and the problems involved in making construction plans are basically the same in each. The first problem is inertia—the "it's the way we've always done it" attitude—which pervades a large segment of our profession. The second is the failure of consultants to be consultants. Finally, but most important, there is the necessity for such speed that there is no time to cautiously develop new approaches to particular problems in individual projects. Under the present pressures we seem to be in the position of getting quantity or quality, but seldom both. However, both can be attained by a process of simplification and standardization, and both must be attained if we are to meet present demands on the profession and at the same time maintain our standing as a profession.

Use of consultants

No discussion of the construction plans and specifications problem can be confined to the highway department's role or the consulting engineer's role. The two are interdependent in the new program, and the problem requires joint solution. As is well known, most highway departments are extremely short of personnel, and attempts are being made to have subprofessionals do much of the tracing and drafting. In most cases, the use of subprofessionals has helped to speed up production, but for design we are still relying on older personnel who cling to the ways that were adequate fifteen years ago and are finding it difficult to change their methods of operation. Consequently, new personnel are being channeled into the same way of thinking.

In many highway departments there is definite antagonism to consulting engineers. This antagonism stems from the distrust engendered when most consultants were doing bridge and structural work and practically none of them were doing highway work. The early plans produced by many consulting firms when they first took jobs in the highway field were completely inadequate. The consultants first engaged in highway projects tried to do the work with men who, except for riding on highways, did not know what one was, and had no idea of the experience and judgment that go into making up a set of highway plans and specifications.

Even today there are firms which are accepting work on the basis of political connections, personal connections, or past reputation in other fields. Such consultants are trying to produce highway plans with staffs that have had no previous highway design or construction experience. They invariably end up spending a great deal of time in the offices of their client. One does not have to travel far to hear State Highway Department designers and draftsmen complain that they, the drafting-room personnel, are having to do the work for certain consultants.

The solution to the problem of the proper use of consultants is not one that can be pinpointed by project magnitude or by specification. Each case must be considered on its individual merits, and the best possible method seems to me to have someone with an open mind, with background, with experience, and above all with authority, appointed by the State Highway Department to deal directly with the consultants.

The major problem from the consultant's point of view is the time required for a department to arrive at a decision affecting the plans. In actuality, many consultants do nothing more than provide the labor to draw plans which are in accord with highway department standards. Only a few of them actually produce plans representative of their true consulting capacity. They seem reluctant to suggest innovations, and they do not argue or question the design of typical pavement sections and designs given to them by the departments. Indeed, they often choose to follow a set of standards established for previous work without checking its application to a particular problem.

Perhaps the strongest indictment of many consulting firms is that the cost of projects is boosted by the inclusion of items and design features that could be eliminated or redesigned for today's materials and equipment. I do not mean to imply, of course, that a consultant should disregard the suggestions or recommendations of the highway department he serves, but I do feel that recommendations, suggestions, and changes should not be considered mandatory on the part of the consultant or on the part of the highway department. The closed-mind attitude of many highway departments must be overcome, and it is the consultant with his work in different states who can best present for consideration good features of the work done in other states.

Normally such a procedure would take a number of years, but we cannot now afford this delay. Of necessity highway departments must accept new thinking, and consultants must accept responsibility as consultants and not act as mere plan makers.

Simplify plans

There are highway departments which still require a complete set of plans for each phase of a project—that is, drainage, right-of-way, grade, and culture, as well as design. Just recently there came to my attention a five-mile job involving the widening of an existing highway for which the contract plans contained 234 standard tracing and cross-section sheets. When there was plenty of time and each division of a highway department had adequate personnel, such detailed preparation doubtless proved its value in providing for all, or practically all, construction exigencies. However, with today's press to accomplish work, a great deal of unnecessary time would seem to have been expended on such a contract.

One short-cut possible in such a widening project would be tighter qualifications for the contractors, since many highway builders are perfectly capable of doing a widening job from the sketchiest of plans. In my own state we have developed straight-line diagrams for widening work, which show detailed design for major intersections only. By a tight screening of contractors under our qualification system, we allow only those capable of doing the work to take plans. On jobs of this type we have eliminated the profile, since the widening work must of necessity follow the existing roadway. See Fig. 2. Cross sections have also been eliminated except at locations where major slopes are moved back, in which case preliminary sections are taken. From these the amount of earthwork is determined. Then unless a change from the cross section as established is

made in the field, the yardage shown on the contract plans is the yardage paid for, thus eliminating the need for final cross sections. The same is true on new locations, unless there is a change in line or grade, in which case final cross sections are taken.

The Secondary Road Plan of the Bureau of Public Roads has given real impetus to the preparation of plans and specifications for secondary and tertiary road work by permitting state highway departments to use their own judgment and experience and cut down on the waiting time for approval which has always been a sore spot. In our own work we find that a simple survey sheet, such as that in Fig. 1, is applicable for the initial stage of converting dirt roads to surface-treated roads. Where state laws permit, use of an easement, described at so many feet from the centerline of the existing or proposed road, allows the right-of-way department to go back later and pick up the titles. Many times the late completion of the right-of-way plan is the major cause of delay in preparing to advertise for bids.

In the development of construction plans for both the Interstate System and the existing system, photogrammetry has been consistently used in an effort to save as much field work as possible. With some minor changes in staking the alignment, it is possible to use the photogrammetric drawings as construction plans in many flat or uncomplicated rural areas on the existing highway system. The use of large-scale air photos, on which proposed changes can be drawn directly, should be further explored. Delaware's first venture into this field called for placing the negative on transparent film of standard drawing-sheet size, but this has not been too successful. However, the method does lend itself to rapid field inspection and notation without the use of full field surveys, and we believe that the aerial survey companies will develop it to the point where it is accurate enough to be applicable, even on widening jobs. I have already mentioned the use of straight-line drawings, which we believe will also save much time.

A combination of these methods, together with the up-dating of old plans where changes are minor, can result in a saving of time by highway departments and the full use of their own people.

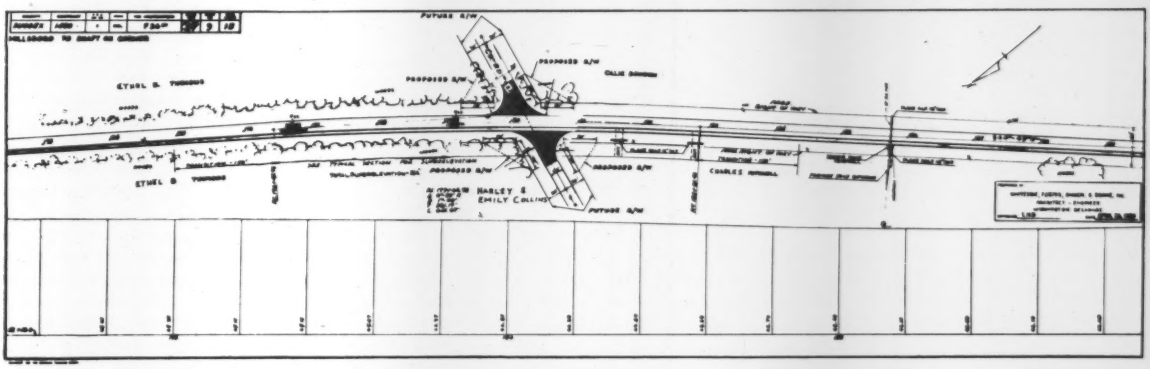
Reduce delays

With reference to specifications, the biggest single headache is the large number of items that have been incorporated in them over the years. I am not alone in the feeling that in many states consolidation is needed. Special provisions should be written by the highway department, since here knowledge of local conditions is imperative, and in many cases the departments end up rewriting the special provisions and discarding much of what has been done by the consultant. Time can be saved by mimeographing or printing the general form of a special provision and having the resident engineer fill in the information that directly applies to his project.

In Delaware we feel that we have made considerable progress in speeding up plan completion and in cutting the time required between the inception of a project and its advertising date. It has taken the cooperation of our entire staff and the consultants whom we employ, but in spite of what has been accomplished and what can be accomplished, we find ourselves in the usual highway department dilemma of waiting for the public utilities to get their facilities out of our way.

(This article has been prepared from the paper presented by Mr. Haber at the Society's Annual Convention in Pittsburgh, in the Highway Division's symposium on "Expressway Problems Unlimited," before the session presided over by Harmer E. Davis, a member of the Division's Executive Committee.)

FIG. 2. This is a typical sheet for a highway widening project in Delaware. On recent jobs, profile of existing roadway has been eliminated as one means of expediting work. Photo depicts stretch of U.S. 113, which has been widened and resurfaced with bituminous concrete.



PRECAST BRIDGE UNITS SAVE TIME AND REDUCE COSTS

For many years the highway industry, through its engineering organizations and trade associations, has been "beating the drums" for an expanded, long-range highway program. Suddenly the dream of many years has become a reality, and the highway engineers find themselves faced with a host of problems demanding immediate solution.

To meet this challenge will require the wholehearted cooperation of highway officials, civil engineers, contractors, and suppliers of equipment and materials used in road construction. It will demand compromise on the part of the various groups, and a wholehearted willingness to see the other fellow's point of view and to believe that each group is striving for the same common goal—completion of the program in the time scheduled.

One of the major road blocks in the highway department is the shortage of civil engineers capable and experienced enough to prepare designs for the many bridges and structures that will be needed on roads built to a much higher standard than has been the rule in the past. Standardization in design is one method of easing the load on the bridge departments in the various states. But by natural inclination, civil engineers as a group resist standardization. They are dreamers and rugged individualists, confident and proud of their ability to solve their own problems, and unwilling to adopt the design of some other engineer. This is especially true when they are subject to criticism from a non-engineer highway commissioner, who seems to think it a sign of weakness or lack of ability for one of his engineers to adopt the standard of another state.

The job ahead is tremendous, and an immense amount of detail will be involved in completing it on time. Every man-hour of engineering that can be saved on any single job must be conserved and applied in the most efficient manner possible, to make up for the shortage of highway engineers, or the profession and the industry will fail to reach the goal. During the time required to prepare the program and obtain the signature of the President to the law, so much was written and spoken about it that the public was made fully aware of the tremendous sums of money appropriated to build the highways of the future. The American people are looking to the highway engineers, and will become very impatient at any delay.

Precast units developed

In 1936 I became interested in the developments in prestressed concrete described by E. Freyssinet in his paper, "A Revolution in the Technique of Utilizing Concrete," delivered before the Society of Civil Engineers of France, British Section, in London in March 1936. At that time some experiments were being carried on in a small way, and efforts were being made to promote the use of prestressed and precast units in the United States. Little interest was aroused, however, among structural engineers at that time. The common remark was, "It is all right for Europe, where materials are high and labor cheap, but the method would not be successful in this country." It has taken twenty years to reach the stage of development we are in today, which is just the beginning of the utilization of precast and prestressed concrete construction.

In 1952, the Arkansas Highway Department was faced with a tremendous maintenance problem, which involved the reconstruction of thousands of miles of creosoted timber bridges built under the WPA program. Because timber was getting high in price and difficult to obtain, as well as of poor quality, it was becoming progressively more expensive and unsatisfactory to repair these old bridges with timber. Alfred E. Johnson, M. ASCE, at that time chief engineer of the Arkansas Highway Department (now executive secretary of the American Association of State Highway Officials), together with John Strom, M. ASCE, bridge engineer for the maintenance department, became interested in using precast concrete units in place of timber in their state's maintenance program.

I agreed, on behalf of my company, to manufacture these concrete units. Soon news items began to appear in local papers over the state carrying headlines such as these: "Precast Bridge Set Up in Record Two and One-Half Hours," and, "Making Bridge History—Eight-Span Bridge Erected in Eight Hours." The amazing speed with which bridges could be put up and opened to traffic was a revelation even to the engineers engaged in the work. Once piles were driven and caps were in place, the bridge units could be set at the rate of one span in thirty minutes to one hour. Contractors found that where they were given work orders on a bridge project the first of the month, they could have the project completed and final estimates paid by the end of the same month.

Precast concrete bridge units proved a boon to maintenance engineers. On emergency work, structures destroyed by washouts or fire could be replaced immediately. Precast concrete units could be delivered from stock direct to the site of the work, and erected at once, thus saving the expense of constructing and maintaining detours, and avoiding complaints from the public.

The use of precast concrete has received a tremendous impetus in recent years because of the increased cost of casting concrete on the job, as well as the delay involved in waiting for it to develop sufficient strength to carry the loads that will come on it. Because of better control of the mix, greater accuracy in forming and placing of steel, better curing conditions, and the equipment available for efficient and economical hauling, it is now possible to produce precast concrete units of much better quality and deliver them to a project at less cost than that of conventional cast-in-place concrete.

Precast concrete bridge units have the added advantage of almost complete salvage value. If a bridge location is changed, the units can be unbolted from one another, removed from the substructure, and transferred to the new location without loss. If it becomes necessary to widen a bridge, the substructure can be widened and the curb unit unbolted, and moved to the edges of the widened section; then additional units can be inserted as required. Precast units are ideal for use in detour bridges required during the construction of new highways, and in such cases the superstructure is completely salvageable.

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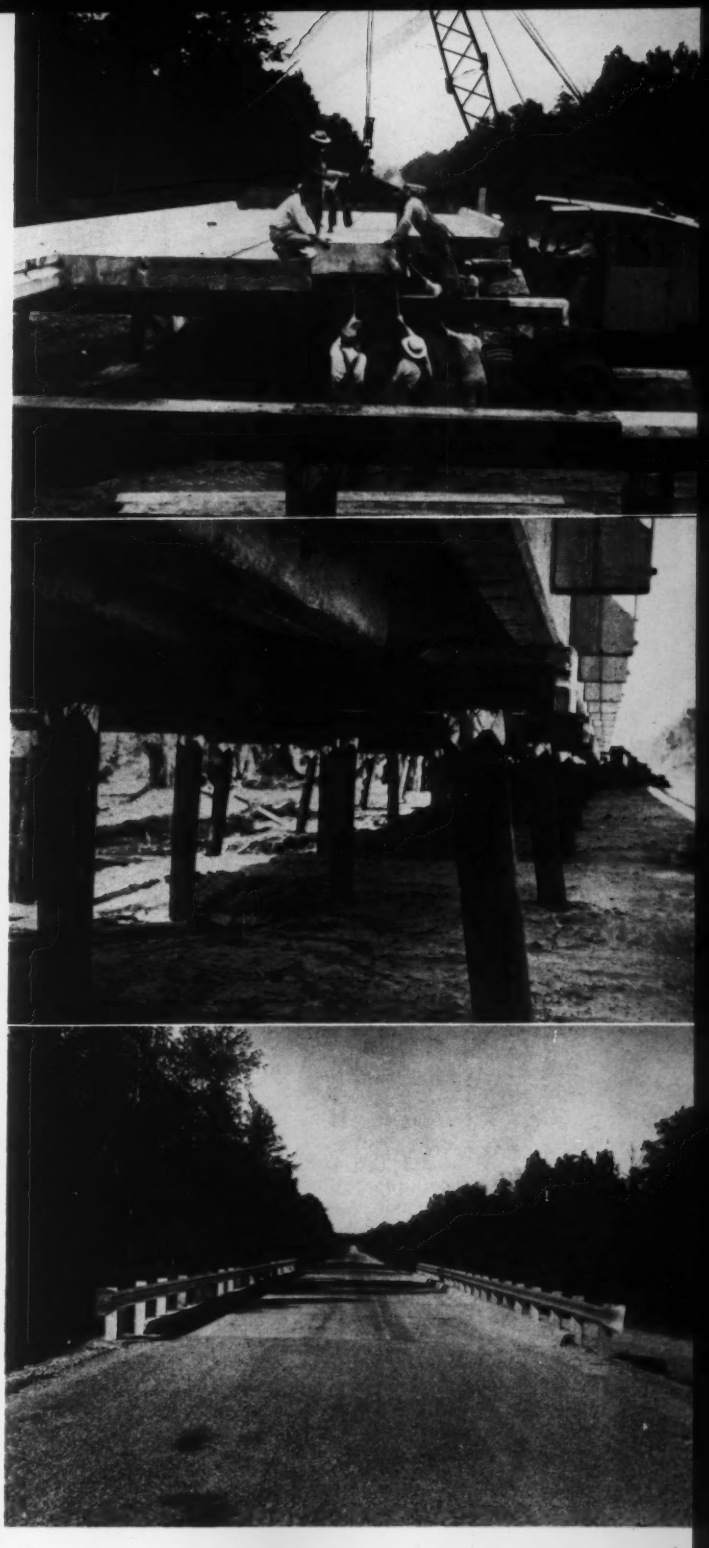
In Arkansas the first units used were 19 ft long, to fit the original wood-decked WPA bridges which had been worn out. These bridges were built with wood stringers 20 ft long, which lapped over 12 in. on the pile caps, so that the pile bents were 19 ft apart from center to center. A few of these old bridges had pile bents on 15- and 17-ft centers. The standard units now being manufactured are 3 ft 6 in. wide, of channel cross section, with a diaphragm across each end and in the middle. The depth of the channel as well as that of the diaphragms is 17 in.; the thickness of the slab is $4^1/_2$ in., and the thickness of the channel legs and diaphragms is 8 in.

Reinforcement consists of two No. 9 bars in each channel leg, and two No. 4 bars in each diaphragm. The slab is reinforced with electrically welded, cold-drawn steel-wire mesh. The edge sections have a 6- x 9-in. curb, 9 in. high, cast integrally with the slab. These curb sections are provided with a 3-in. hole for surface drainage placed adjacent to the curb at the center of the slab, and with dowel-pin holes for doweling to the pile caps. The slabs have two holes that extend laterally through the legs of the channel for bolting the slabs together transversely, and there is also a hole through each end diaphragm for bolting the sections together longitudinally in multiple-span bridges. Each 19-ft-long section weighs about 8,500 lb.

Since the various states use varying roadway widths and have varying definitions for roadway width, several special sections are manufactured. Special sections $2^1/_2$ and 4 ft wide, as well as a curb section 3 ft 9 in. wide, are produced so as to provide any roadway width desired. These units are cast with or without a keyway running longitudinally along the outside surface of the channels, because some state highway departments require keyways and others do not.

Precast concrete guardrail posts are furnished, which can be bolted to the curb sections and which provide for the attachment of a beam-type metal guardrail to complete the structure. Precast reinforced-concrete pile caps are also produced. These caps, made



Precast concrete deck units are placed on creosoted pile-supported bents in construction of state-aid highway bridge in Newton County, Miss., by county forces. Roadway 23 ft wide is provided at cost of $79 per lin ft for entire bridge, including substructure. Designed for H-15 loading, units are bolted together both longitudinally and laterally with bolts of 1-in. diameter.

Widening job was started at 8:00 a.m. and completed at 3:00 p.m. on Tennessee Highway 18, between Jackson and Bolivar. Work consisted of driving additional piles at sides, removing old wooden floor, and placing precast concrete deck units. Note special lifting yoke for these units.

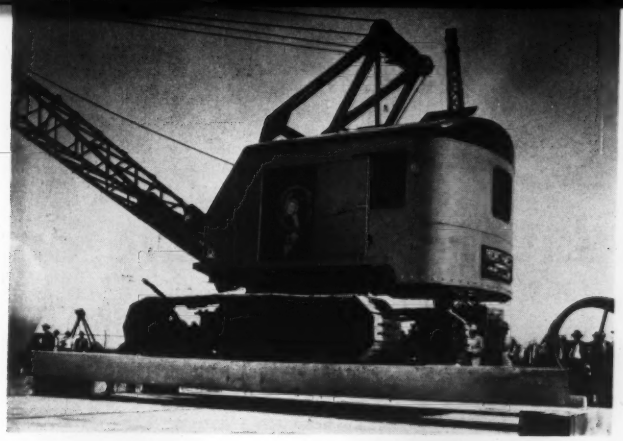
Concrete piles and precast caps support precast deck units, each 19 ft long and weighing 8,500 lb. Note that precast posts supporting metal guardrail are bolted to curb deck sections on this federal-aid project in Union County, Arkansas.

with and without a crowned top, are provided with holes for doweling to timber piles. A demand for slabs to fit skew bridges has been met by manufacturing skew units for bridge decks with 15- to 45-deg skews. These units are used with various types of substructure, such as creosoted timber piles and creosoted caps, or creosoted timber piles with reinforced concrete caps, or with reinforced concrete piling and concrete caps. Units have been manufactured for bridges on vertical curves as well as for those on a 4-deg horizontal curve, with superelevation provided in the surface. When used in cities, these precast bridges can be provided with sidewalk sections, constructed by using additional interior and curb units outside the roadway section to form a sidewalk of any width desired. The use of these adaptable units is only limited by the imagination of the highway engineer.

In our yards, the bridge units are cast in rigid steel forms, heavy enough to withstand the vibration required to place the low-slump concrete. Rigid specifications limit variation in any dimension of the unit to $^1/_8$ in. Extreme care is taken during steam curing and yard storage to prevent warping.

Standardization reduces cost

Standardization in the various states would help reduce the cost of precast concrete construction by enabling the manufacturer to utilize equipment and forms in various plants, and also would reduce the inventory he is obliged to carry in stock because of the wide variety of units necessary to meet the varying requirements of different highway departments. Some states consider the 24-ft width as the dimension taken at the top of the curb. Others use the dimension at the base of the curb. Some use units without keyways, and those that do require keyways demand differing keyway dimensions. Some use a flat roadway surface while



Two post-tensioned bridge units 31 ft long support 45-ton dragline excavator. Post-tensioned with stressed steel bars, units are designed for H-20 loading. Except for their length, these units have same dimensions as the 19-ft precast units designed for H-15 loading.

others require a crown. There are also many minor variations in such features as diameter of holes, size of bolts, location of bolt holes, character of reinforcing—all of which could be standardized so as to reduce the cost and increase the efficiency and service that the manufacturer can provide.

There is a serious need for a realistic specification covering the manufacture of precast reinforced concrete units when manufactured in recognized manufacturing plants. The specifications in use today were written primarily for work cast on the job, such as precast concrete piling manufactured on the job or monolithic construction in the field. Specifications that require precast concrete units to remain in the forms for more than one day merely destroy the efficiency and add to the cost of the factory-made product. By using steam curing, with low-slump vibrated concrete of high cement content, it is common practice to produce concrete which has a compressive strength of 3,000 to 4,000 psi in twenty-four hours.

Precast reinforced concrete units, manufactured under these conditions, can be safely removed from the forms in one day. There are no restrictions on the time that reinforced concrete pipe must remain in the forms. This product has been used in large volume in highway construction, for many, many years with excellent results. Precast reinforced concrete bridge units should be accepted on the basis of meeting certain strength and design requirements—that is, on the same basis as reinforced concrete pipe.

Tests demonstrate strength

The units described above were designed on the basis of the H-15 highway loading, but when tested under actual load developed strengths equivalent to the H-20 loading without failure. The first test was conducted on a single precast bridge unit 19 ft long, supported at the ends. The load was applied through a 12-in. square steel plate placed in the center of the slab. The test was conducted by the Engineering Experiment Station of the University of Arkansas under the direction of Prof. James R. Bissett, A.M. ASCE, at the shops of the Arkansas State Highway Department in Jacksonville, Ark. SR-4 strain gages were used, attached to the steel and concrete. When a 25,000-lb concentrated load was applied, the stress in the concrete was only 565 psi, and the stress in the steel, 26,850 psi. There was no yielding of the bridge unit until after a 32,000-lb load was applied, and the ultimate load carried was 45,000 lb.

Tests were also conducted at the Highway Research Laboratory at Mississippi State College under the direction of Prof. Dewey McCain, M. ASCE, head of the Department of Civil Engineering, and of R. M. Scholtes, J. M. ASCE, instructor in this department. These tests, conducted at the request of the Mississippi State Highway Department, were made to determine the effect of keyways in transferring load from one unit to the adjacent one.

Tests were conducted on single units without keyways, with the load applied at the center of one edge of the unit through a 3-in. X 15-in. I-beam. Under these conditions the unit was supported at its four corners and sustained an ultimate load of 45,000 lb. A test was then run on two units joined together by a keyway grouted with dry-pack concrete. The load was applied in the same manner as on the single units, that is, at the center of one edge of one unit adjacent to the keyway. These slabs were also supported at the four corners, and load cells were used to indicate reactions at the various points. When tested in this manner, the units sustained a concentrated load of 85,000 lb, which indicated nearly complete transfer of load by the keyway.

When the units were removed after the test, it was found that the keyway had remained whole throughout its entire section, except for the failure crack at the center of the span, and showed no spalling or other failure of any sort. The ultimate load on the unit when tested in shear was 88,000 lb, applied on one edge of a single unit, 1 ft 10 in. from the edge.

The economy of this type of construction is demonstrated by the fact that, when alternate bids have been taken against other types of construction—even against a bridge constructed entirely of creosoted timber for an H-10 loading—in most cases the precast-unit type of construction has proved to be cheaper. Bridges built under contract with precast units have shown a construction cost in place, completed, of $4.00 to $5.00 per sq ft, depending on the type of substructure used. Where creosoted timber piles and timber caps are used, this type of bridge, with concrete guardrail posts and beam-type metal rail, has been built for as little as $3.50 per sq ft.

Post-tensioned units of 31-ft span

The span length has been recently increased. It was found that sections 31 ft long could be built with identically the same cross section as the 19-ft sections, and with the same total area of steel, except that high-strength stressed-steel bars are used and post-tensioned to furnish a prestressed design that will carry an H-20 loading. These units weigh about 12,500 lb and can be readily hauled and erected on the job. They have the same keyways and bolt holes as the 19-ft precast sections.

Bridges using these units have been and are being installed in Mississippi, Tennessee, and Arkansas. The first one was erected in Hinds County near Jackson, Miss., by County forces. It consisted of a 31-ft prestressed center span with a 19-ft precast span on each end. The cost of the 31-ft spans is approximately $4.00 per sq ft for the deck, exclusive of the substructure.

The writer is greatly indebted to Eric Erickson, Chief Engineer of the Bureau of Public Roads, Ben T. Collier, M. ASCE, State-Aid Engineer, Mississippi Highway Department, as well as to Messrs. Johnson and Strom, previously mentioned, for their encouragement during the early days of promotion and production of these precast reinforced-concrete bridge units.

Electronic computers save time on

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In January 1955 the decision was made to determine the feasibility of providing a computation service for engineering calculations within the California Division of Highways. The purposes were to expedite the plans for an expanded highway program and to relieve the engineers of tedious, time-consuming routine calculations. Investigation revealed that centralized machine computation of traverses and earthwork would accomplish both these aims. The applications were found feasible on the IBM punched-card tabulating equipment in the California Highway Planning Survey in Sacramento, and the service was made available by air mail to eleven highway districts within the state and to the headquarters of the Division of Highways in Sacramento.

Magnetic-drum type of processing machine is one of electronic computers used for computations discussed in this article.

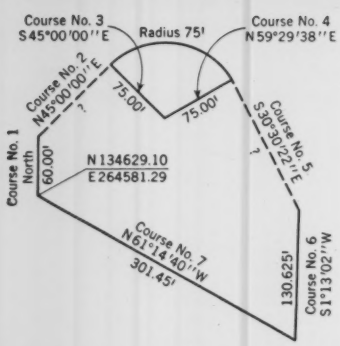

FIG. 1. Typical traverse that can be solved with electronic computer contains two unknowns. Here lengths of courses Nos. 2 and 5 are unknown. Traverse sheet for electronic computation is shown in Fig. 2, and tabulated solution in Fig. 3.

The service offered for traverse computations will handle up to two unknowns in any traverse; that is, a bearing or a distance can be unknown, or both. The number of courses in a traverse is limited to 98. Traverse adjustment by the compass and transit rules is also made. We are currently averaging over 2,000 courses a day and have handled as high as 3,000. A sample of a typical traverse is shown in Fig. 1. A sample traverse sheet for this same traverse is shown in Fig. 2, and the results in Fig. 3. In this particular traverse, the area was also requested and is shown in square feet and in acres.

For earthwork computations, the procedure was planned for maximum flexibility. Computations on earthwork quantities can be made for advanced planning, design, or for final pay quantities. A standard roadbed template may be used or the section may be complicated by varying widths, superelevations, transitions, and other known standard factors. A complete set of notes or selected portions of it may be reused and shifted laterally or vertically if desired in determining the final line and grade. These same cards can be used as the basis for final pay quantities modified as necessary to reflect construction changes. Terrain data can be reused for the calculation of quantities for frontage roads or ditches.

Terrain notes, taken in the form shown in Fig. 4, can be reduced and tabulated from rod readings, or elevations can be obtained based on differences from elevations at centerline or offset points. The resulting calculations of earthwork and mass diagram ordinates are shown in Fig. 5. Tabulations of computed catch-point elevations and distance from centerline can be furnished also for plotting the limits of the work for right-of-way acquisition, and for setting slope stakes in the field.

traverses and earthwork

If roadbed notes are given to finished grade, correction quantities to subgrade can be given as added items and combined with the calculated quantities. Similarly, calculations for frontage roads can be combined mechanically to obtain the quantities of excavation and embankment and the composite mass diagram ordinates.

Computing service procedures

For the engineer to adopt the computing service for traverse calculations requires a somewhat different approach to the problem. One of the greatest obstacles to be overcome was the reluctance of engineers to tolerate a waiting period of a day and a half between submission of the problem and the return of the completed computation. At first many of the engineers would not accept this delay, as they had been accustomed to using the answer to one calculation as a known quantity to continue on to the next calculation—a procedure that resulted in a string of interdependent traverses.

To obtain maximum benefits from the new service the engineer must, whenever possible, plan his work to avoid interdependent traverses. Controlling networks must be submitted in advance of detailed computations in order not to hold up later work. The engineer should write as many independent traverses as possible for one portion of the work and go on to other sections of the work while the computations are being done for him. As an aid in this procedure, certain non-critical distances or bearings may be measured from a scale drawing of the area, leaving only two unknowns to be solved.

While it may be difficult for the engineer to get used to the change from the usual procedure, the savings make it well worthwhile. Estimates made under the manual procedure showed a cost of 13 cents per course, checking not included. With the volume of work now being handled, we are able to furnish this service on the basis of 5 cents per course. To obtain an estimate of saving in engineering time is not easy since, first, there is no such thing as a typical job, and second, direct comparisons with

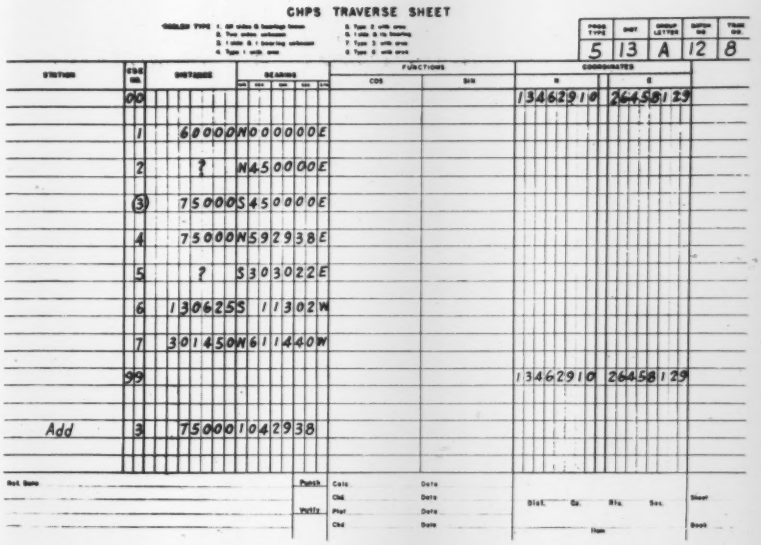

FIG. 2. Traverse sheet for Fig. 1 shows typical form as submitted for electronic computation by engineer in district office.

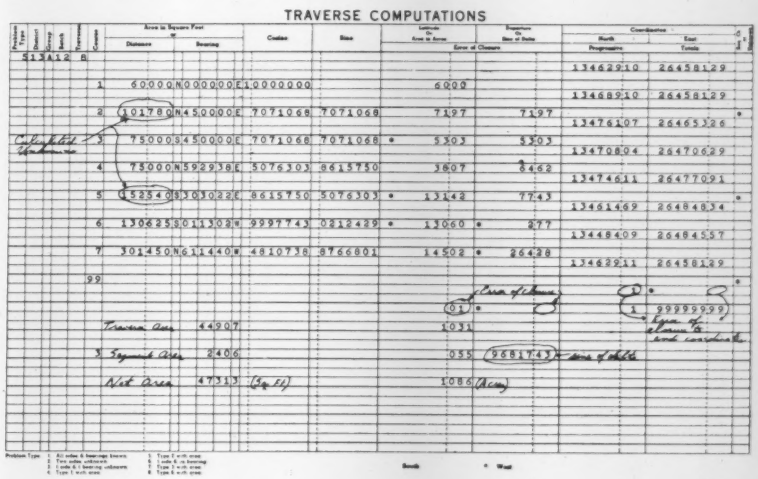

FIG. 3. Solutions for traverse problem of Fig. 1 are shown as returned to engineer in district office after electronic computation.

conventional methods are difficult because of the revised approach necessary for greatest efficiency under the machine method. However, users of the service inform us that the savings to be realized are appreciable. Some examples follow.

1. One squad leader, who formerly used from three to five men for calculating in the designing process, now uses from one to two.

2. Another squad leader reports that one of his men was able to complete the geometric design of three freeway interchanges in two weeks.

3. A man volunteered the information that he designed an interchange in approximately half the time formerly required.

Estimates of the amount of engineering time required to compute earthwork quantities are also difficult to pin down. It is possible to furnish an engineer the tabulations previously mentioned for a ten-mile section through rolling terrain within a week after the punching phase. Calculations for several projects may be in process simultaneously. This compares with estimates of four engineering man-months required to do the equivalent work in a district office. The engineer has eliminated plotting and planimetering except for typical and critical cross sections. The cost of machine computing service has averaged under $50 per mile.

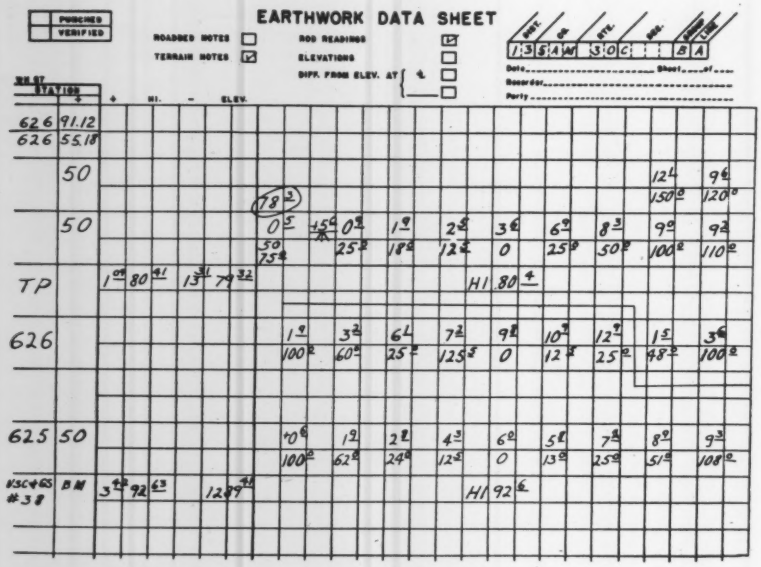

FIG. 4. "Earthwork Data Sheet" shows form used for terrain notes. See Fig. 5 for results of computations.

Magnetic-drum machine still faster

By January 1956 it was realized that the potential volume of earthwork computations within the Division of Highways would be so great as to make it virtually impossible to maintain the service with the equipment available. Upon investigation it was determined that a magnetic drum data processing machine would handle the volume satisfactorily. In May 1956 the computer was installed and programs were tested.

Our limited experience with this equipment has already shown that not only can the elapsed time in obtaining results be reduced but also that greater accuracy is possible. The greater accuracy obtained is due in part to the increased reliability of the drum calculator, but primarily to the reduction in card handling. For example, in earthwork computations with the tabulating equipment, the deck of cards for a preliminary line had to be processed over 60 individual steps after key punching. This procedure is reduced to seven steps with use of the magnetic-drum data processing machine.

The possibilities for using the processing machine for other engineering problems are practically unlimited. We are currently in the process of programming several problems for our Bridge Department, one of which involves the design of a composite beam. We are also programming the checking of aerial contour maps based on four points of known elevations and two points of horizontal positions whose elevations are known. These two points may be duplicates of the previous four. Additional applications, such as traverse adjustment by least squares and triangulation are possible and are being scheduled.

EARTHWORK QUANTITY SHEET

DIST	COUNTY	ROUTE	SECTION	GROUP	LINE	STATIONING +	SHRINKAGE FACTOR	EXCAVATION END AREA SQ FT	EXCAVATION CUBIC YARDS	EMBANKMENT END AREA SQ FT	EMBANKMENT CUBIC YARDS	MASS DIAGRAM ORDINATE
17	08	A	2A	1	C	B 281 0000	8570	44964				
						ADDED	8570		216843			
						ADDED	8570		110400			
									205803 •			• 17637
									205803 •			•
						282 0000	8570	72131				
									260885			
						ADDED	8570		451100			
						ADDED	8570					
									215775 •			• 36189
									215775 •			•
						283 0000	8570	68747				
									196644			
						ADDED	8570		115600			
						ADDED	8570					
									163084 •			• 50185
									163084 •			•
						284 0000	8570	37441				
									84948		21106	
						ADDED	8570		52600			
						ADDED	8570				430	
									79488 •		21536 •	• 54780
									79488 •		21536 •	•
						285 0000	8570	8431		11397		
									7944		48480	
						ADDED	8570				550	
									7944 •		40950 •	• 51366
						5000	8570	149		32235		
									178		48468	
						ADDED	8570				690	
									178 •		49158 •	• 46462
									8253 •		90108 •	•
						286 0000	8570			20110		
									1107		27696	
						ADDED	8570				630	
									1107 •		28326 •	• 43733

FIG. 5. Earthwork quantities and mass diagram ordinates, after solution by electronic computer, are listed neatly on "Earthwork Quantity Sheet."

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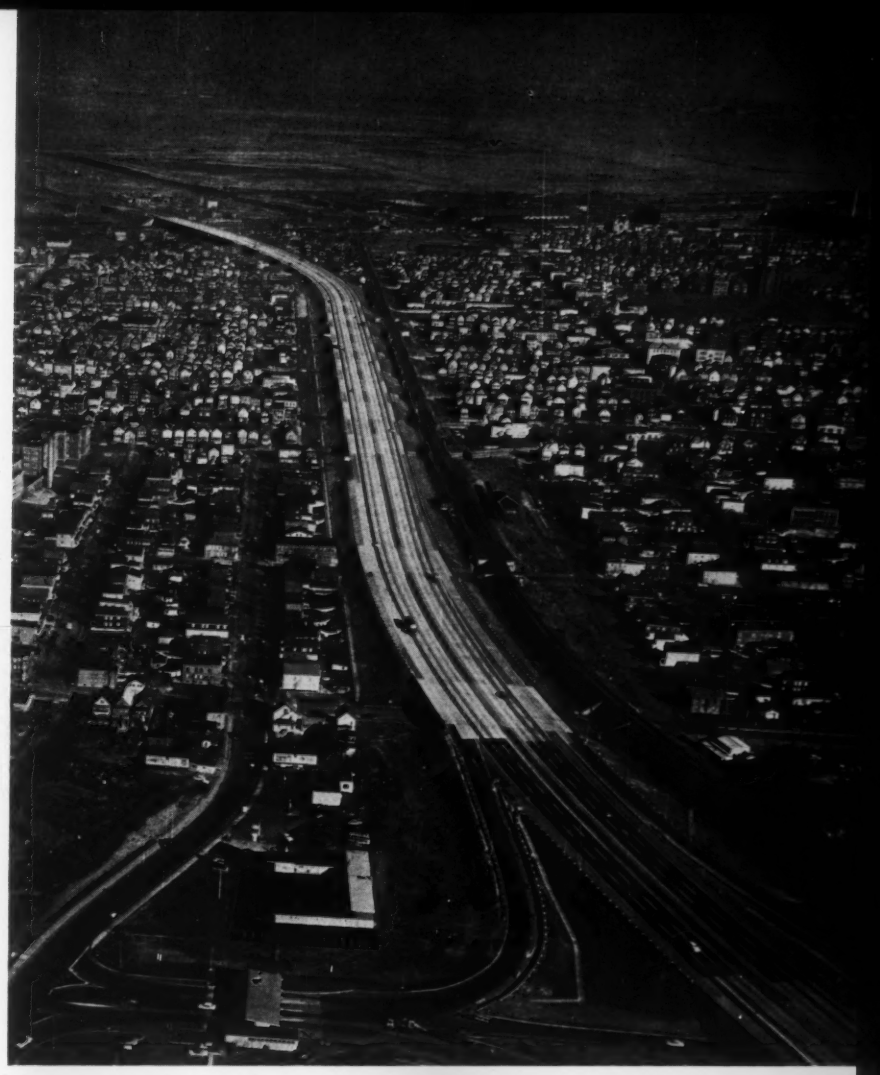

Section of New Jersey Turnpike is typical of structures that will be encountered by consultants on new highway network. On such work, mutual understanding between state highway departments and consulting engineers will greatly expedite design and construction.

Contracting for consulting services

Understanding by public officials and consultants of their mutual problems is necessary for the efficient and economic employment of materials and manpower in meeting the challenge of the national road-building program. The ideas expressed in this article represent only the author's views and do not necessarily reflect those of the principals of his firm. It is hoped that this frank discussion will contribute to the mutual understanding so essential to the road program. This article is a shortened form of Mr. Gray's paper presented at the ASCE Annual Convention in Pittsburgh, in the symposium, "Expressway Problems Unlimited." This Highway Division session was presided over by Harmer E. Davis, a member of the Division's Executive Committee.

Most of the problems to be discussed here are not new. However, they are problems that may assume new importance in the execution of the recently authorized federal highway program. It is taken for granted that the consulting engineer in private practice will perform a useful and necessary role in carrying out the new highway program. While for some decades the consultant's usefulness was limited to the solution of special problems, in the past decade he has, in addition, been called upon to help increase the output of state and county highway engineering departments whenever a suddenly en-

larged annual program proved too heavy for existing official personnel. It is the peculiar habit of the taxpayer to look with disfavor on sudden increases in official payrolls. The private consulting engineer is not hampered by such restrictions and can expand and contract his staff with greater ease than an official agency. In some instances special legislation has been required to authorize officials to engage the services of private firms. It is in the agencies which have not had extensive previous experience with private firms that many of the problems of the consulting engineer are likely to arise, although they are by no means confined to them. We like to think that these are mutual problems, in the solutions of which public officials have as much long-range interest as the consulting engineer.

Can consulting engineering firms capably handle the complete design of a section of a modern limited-access highway? The answer today is an unequivocal yes. Many private firms have already successfully completed many such sections. By dividing projects into a number of sections, and apportioning them among experienced engineering firms, it is possible to make the immediate start required for projects of this kind. The succession of highway projects, which most of the large firms have had over the past several years, has enabled them to assemble competent staffs of highway engineers. It has also convinced some of the highway departments that, with care in the selection of the engineer, they can safely entrust the design of complete highway sections to private firms. To illustrate this, an official of one large highway department recently remarked to me that his department currently has contracts with fifty such firms.

Problems of the consultant

What are the problems that beset the consulting engineer in his dealings with various official agencies and how do they arise? It is obvious that no exhaustive treatment is possible here, so only the problems that arise most frequently will be touched on.

Basically many of the difficulties arise from the current practice of not defining the scope of the service contracted for in sufficient detail. This practice is not mere carelessness. It grows out of the complexity of the services entailed in the preparation of complete design and construction plans for a section of modern limited-access highway. There is a question of what basic data will be supplied by the contracting agency, and how complete and up to date these data are. Also, how soon will the data be made available? These matters vary greatly from one agency to another and cannot be taken for granted. To avoid misunderstandings which can be troublesome for the agency and ruinous for the consulting engineer, all such details should be as fully covered in the written contract as possible. Even with the best-written contracts, there may be misunderstanding as to what the fee is intended to cover.

This leads to the question of size of fee, and how to determine it. The ethics of the Society and the attitude of reputable engineers prevent competitive bidding on engineering services. Such an attitude is not the manifestation of a selfish desire to guarantee a high level of fees for engineers. It is a sound policy which can do as much for the contracting agency as for the engineers it contracts with. When one reflects on the fact that design fees on large projects may range from approximately 2.5 to 4 percent of the construction cost, depending on the size and complexity of the project and on the quality of the service rendered, it is evident that the difference between a "high" and "low" fee for a particular project can hardly be greater than 0.5 percent of the construction cost. Will any understanding official argue that saving 0.5 percent in this way is a true economy?

The speaker is personally acquainted with instances where poor engineering has resulted in extra construction costs as high, in extreme cases, as 100 percent. Yet, at this moment there are official agencies whose choice of engineers is strongly influenced, if not entirely dictated, by the size of the fee. The reputable consulting engineer asks merely that the fee be set at a level which will permit him to do a conscientious job.

The method followed by the official agencies that have been dealing with consulting engineers for some years is to select a particular firm whose previous experience gives some assurance of its ability to do a particular job, call its representatives in, and discuss the project in detail. Both sides normally raise many questions, leading ultimately to a determination of the scope of the services to be contracted for. The responsible engineer will then require at least several days to visit the site and estimate his costs before submitting his proposal in writing. If the contracting officer believes the proposed fee is higher than necessary, he can call the engineer in again to discuss the matter until a mutually satisfactory arrangement can be worked out.

Dealing with more than one engineer for a particular assignment is wasteful of the time of both the engineer and the agency. Ultimately, too, it is likely to lead to too great emphasis on the size of the fee by both parties, with resulting lowering of standards of performance by the consulting engineers dealing with the agency.

The contracting agencies can do a great service to the civil engineering profession by keeping fees in proper perspective. In the final analysis, their judgment in the selection of engineers and the establishment of proper fees, as well as their insistence on obtaining value for the fees paid, will establish the level of quality of engineering work performed by private engineering firms.

Contract details

Preliminary alignment studies. These studies may be handled as a separate contract or a separate phase of a comprehensive contract. The widest possible divergence of opinion exists as to how thorough these studies should be. The practice of calling for a lump-sum quotation is definitely bad. If at all feasible, such work can be performed most satisfactorily by the agency's own engineering department. If not feasible, it is best contracted for on a cost-plus-percentage basis. The determination of the original alignment is certainly no place to pinch pennies. Adequate time and money for this phase of the work will pay dividends later in convenience of use by the public and low initial and maintenance costs.

Surveys for property acquisition. While it is not too difficult for the consulting engineer to estimate the cost of surveys for design, he cannot possibly estimate how much or how little to allow for surveys for the purchase or appropriation of property. Nor can he propose a lump-sum amount for each such survey. These matters are best handled on a cost-plus-percentage basis or by allowing a lump sum per day for each four-man survey party.

Subsurface exploration. The consulting engineer is generally opposed to having the cost of core borings for structures included in his fee. A more satisfactory and common practice is for the agency to pay for the cost of the borings, and for the engineer to provide layout and inspection within his general fee.

Extra work. No matter how carefully a project may be worked out in the preliminary stages, there is always the possibility of some unforeseen extra work arising in the final design stage. Where the basis of payment for extra work has been established in advance in the engineering contract, this extra work may be authorized quickly, as is frequently necessary. Without any question whatever, it should be author-

ized and acknowledged in writing when the occasion arises.

What constitutes extra work may be a problem. Since in most cases the fee is a percentage of the construction cost, a mere enlargement of the length of line need not be considered extra work, providing it is agreed that: (1) the same percentage fee is to apply to the added section, (2) the nature of the added work is not to be substantially different from the original section, and (3) the timing of the addition does not work a hardship. To cite an example, it certainly would not be equitable to add later to an ordinary highway engineering contract the design of service facilities, such as maintenance buildings, at the same percentage fee.

The commonest method of compensating for extra work is on a cost-plus-percentage basis. The difficulties arise when the contract is not clear as to exactly what is meant by cost and to which elements of the cost the percentage is to be applied. The contract should state clearly whether the usual payroll loadings of taxes, insurance payments, and holiday pay are included. It would help further to include statements as to whether or not prorated annual vacation and sick leave are reimbursable. A statement as to whether other incidental expenses, such as blueprinting, telephone, and travel expenses, are reimbursable will avoid difficulty later when the bill is rendered.

Delayed approvals, an old problem

One time-honored problem for the consulting engineer is the length of time required to secure approvals of designs submitted. While many agencies handle this very well indeed, there are others whose record is so bad that the informed engineer will avoid them if work can be obtained elsewhere. There is very little that can be done about this basic problem for it is as fundamental as the faults in human nature itself.

Lest anyone doubt that long delays in securing approval of preliminary submissions have a damaging effect on the consulting engineer's costs and, ultimately, on the quality of the work, let us consider what happens in the design office. Such delays upset scheduling of the design work, making it difficult to keep the same personnel for further development of the same plans. In the continual reassignment of personnel there is obvious waste of man-hours incidental to orienting the individuals concerned in a new problem. In addition, lack of familiarity with the project can lower the quality of the completed work. A solution to this troublesome problem is needed.

Another related difficulty is that of changes in design after a substantial investment has already been made in the original design. This problem is well handled in many contracts by arrangement to submit fairly complete preliminary designs and secure formal approvals before proceeding with the harder work of making final designs and completing plans, specifications, and final engineer's estimates. Such contracts often provide for payment as extra work for any substantial changes after preliminary approval. It is the principal reason for inclusion of changes covering payment for extra work.

There can be no question whatever that occasional changes are to be expected in the development of final designs. The basic question is how far the consulting engineer is expected to underwrite such changes. Happily, many agencies have a good understanding of the effect of changes on the consulting engineer's costs and readily authorize payment for such extra work.

Still another aspect of the problem is payment for engineering work omitted from the construction contract. A simple example of an actual case will illustrate the point. A small county road was to be carried on a new bridge over a new major highway under design. After plans for the bridge were well advanced, it was discovered in negotiations with the county officials that the bridge could be eliminated and the county road relocated at about one-tenth the cost of the new bridge. The investment of the consulting engineer's time in developing the bridge plans would have been repaid by application of his fee percentage to the construction cost of the bridge, if it had been built. With the bridge eliminated, some other means of compensating the engineer had to be found. In this instance, it was equitably settled by estimating the design cost of the omitted bridge as far as the designs had been carried, and paying under the same arrangement as for extra work, namely, cost plus a percentage.

This example gives rise to the question, "Is the engineer entitled to a profit on such work or should he merely be reimbursed for his costs to prevent actual loss?" It is generally held that he is entitled to a profit on any work actually performed. The basis of this reasoning is simple enough. It rests on the fact that the engineer did in good faith perform the work under the terms of the contract, which in normal circumstances would have enabled him to earn a profit.

Fee payments

All properly drawn engineering design contracts contain detailed statements concerning the schedule of payments of fractions of the fee while the design is in progress. The commonest method is to permit billing at monthly intervals based upon approved percentages of completion of design. However, in some instances, another method is used, based upon acceptance of some completed phases of the design work such as the preliminary design and plans or final plans in pencil form. Where the project is large, the latter arrangement can place heavy financial burdens on even the largest consulting engineering firm, and the practice is a bad one in my opinion. It not only tends to strain the credit of the engineer, but on large projects it results in very appreciable short-term interest costs which must either be borne by the engineer or affect the size of his fee.

Similarly, until the actual total construction cost has been established, the retention of 10 or even 5 percent of the design fee, works on unnecessary hardship on the consulting engineer. I have in mind a recent case where exact establishment of the construction cost was not possible until three years after the delivery of all contract documents. It is not too difficult to work out a procedure in the contract to permit payment of all but a very small fraction of the design fee on the award of construction contracts. The only reason for retention of even a small fraction of the design fee is the fact that where the design fee is based on construction cost, the exact figure is not known until the final payments to the contractors have been computed. Most official agencies are averse to overpaying anyone, even though the reputation and financial standing of the engineer assure repayment in case of error.

I believe it is evident at this point that many of these difficulties spring from either the unwillingness or the administrative inability of the chief engineer to use his discretion in ruling on matters not clearly covered in the contract. It is extremely frustrating for the consulting engineer to find that everyone familiar with the facts in a given case is agreed that, in simple justice, he is entitled to a reasonable compensation and yet to be told that some fiscal officer has ruled against it.

The constant reference to problems throughout this article may have created the impression that the picture for the consulting engineer is black indeed. This is certainly not so. I have had much pleasant proof of an understanding and eminently reasonable attitude on the part of officials with whom I deal. I believe that the more fully these matters are discussed the fewer problems will arise to plague both parties in the execution of work.

MUTUAL RESPONSIBILITIES OF ENGINEER EMPLOYER AND EMPLOYEE

Views of an employee in public service

THOMAS B. LEE, J.M. ASCE

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A study of engineering periodicals of the past decade indicates that the engineer employee is dissatisfied with his lot. Numerous articles and letters to the editor have been written on such problems as salaries, professional standing, social recognition, unionization, unity organizations, bidding by engineers, strengthening of registration laws, and advertising by engineering firms. A recent survey of the ASCE membership disclosed that some 25 percent of those polled believed collective bargaining would be advantageous to them.

Regardless of whether engineer employees in general are dissatisfied, it is evident that a considerable number of them feel that their profession is not giving them the satisfaction it should. The profession should be concerned about this dissatisfaction and should determine the root of the trouble and correct it. An easy answer to this problem, which has been advanced by some, is that all the fault lies with the employer. This is far from the truth, but like many half truths, it may be difficult to refute.

The relationship between the engineer employee and his employer must be a two-way affair with communication necessarily flowing in both directions. The employee has definite responsibilities to his employer and the employer has equally definite responsibilities to his employee. What are these responsibilities we talk so much about and how can they be met?

Employee responsibilities

In my opinion, the following are the chief responsibilities of the engineer employee to his employer:

1. **Integrity**
2. **Loyalty**
3. **Technical ability and the desire to improve it**
4. **Pride in his work and profession**
5. **Good social behavior**

In this day and time, some may accuse me of being old fashioned in listing **integrity,** but the first prerequisite of a true professional man is that both his social and professional integrity is above suspicion. Our Code of Ethics is our yardstick of professional integrity and should be scrupulously adhered to in all particulars. It is impossible to maintain professional integrity without social integrity; the two supplement and complement each other.

The second responsibility, **loyalty,** is a prime requisite for the engineer employee. The employee should be loyal to his employer, his superiors, his associates, and above all to himself and the public he serves.

Too many are inculcated with the idea that they should "get something for nothing" and "the world owes them a living." Many are more interested in having a job than in doing a job. If the employee is to be loyal to his employer, he must give his best on every job, do more than is asked—never less. If an employee is to be loyal to himself, he must stand up and fight hard for what he believes to be best, yet when the decision of his employer or superiors goes against him, he must carry out that decision to the best of his ability. The engineer employee's trust to further the public health and welfare must never be compromised under any circumstances. If such a compromise is made, an engineer is not true to his professional ethics or to himself. Our Code of Ethics requires each engineer to act for his client or for his employer in professional matters as a faithful agent or trustee. It is a disgraceful fact, but none the less true, that too many employee engineers have no real interest in their work or their employer and are only concerned with pay day and quitting time.

The third responsibility of the employee is to improve his **technical ability.** The engineer employee must give his employer the best of his technical know-how and have the necessary courage and persistence to finish the job at hand in spite of obstacles. He must possess the power of analysis and at the same time be able to synthesize his knowledge and coordinate the various principles involved in solving the problem at hand. The employee should be systematically adding to and broadening the scope of his technical knowledge, with special emphasis on the present and future needs of his employer.

The next qualification is **pride in his work and in his profession.** The engineer employee should always turn out work to which he can point with pride. The satisfaction of a job well done is priceless. He should participate wholeheartedly in his professional and technical societies and be willing to serve in any capacity. There is no place in the engineering profession for one who cannot subscribe with his whole being to Section 10 of the Code of Ethics, which concerns acting in any manner or engaging in any practice which will tend to bring discredit on the honor or dignity of the profession.

Last but not least of the employee's responsibilities is his **social behavior.** The employee should always remember that in all his actions he can bring either credit or discredit on his employer and on his profession. This is true not only in professional dealings but at the social level as well. An inebriated employee at a country club dance can lose a prospective client for his employer. The employee should be neat in his appearance, and above

all should watch his tongue. He should study people and learn to work with them. In the past we, as a profession, have been guilty of underestimating the importance of this last item.

Maybe we could sum up all the employee's responsibilities by saying, "By our deeds they shall know us."

Many may feel that this view of the employee's duties and responsibilities is over-idealistic. That may be so—but if we are truly members of a profession, our goals must be high and we must strive at all times to attain them.

Employer has responsibilities too

The employer also has responsibilities, which may be listed as follows:

1. **Integrity**
2. **Recognition of an employee's technical ability**
3. **Salary commensurate with training and responsibility**
4. **Security of employment**

The prime requisite of a profession is **integrity,** and the employer has no less responsibility than the employee in maintaining the highest integrity in all his dealings.

The second responsibility of the employer is **recognition of an employee's technical ability.** There are many facets to this item, and many complaints by employees can be catalogued under faulty recognition. There are many places where the professional engineer should be relieved of subprofessional duties. We have recently begun to take cognizance of this fact only because of the shortage of engineers. A complaint often heard is that the employee's opinions are not valued, and that if he is asked for an opinion, it is only on minor matters. Definitely, engineer employees want to be "on the inside" as members of the management team. The employer who recognizes this fact will endeavor to establish a mutually advantageous relationship between himself and his engineer employees. Coincidentally he will get more and better work, and thus a measurable economic return.

The employer should make every effort to encourage his engineer employees to attain higher professional standing and to increase their technical ability. Their increased ability should then be recognized in an appropriate manner. The wise employer will see that his young engineers are in daily contact with men they can admire and emulate, since the best teaching is by example.

The third responsibility of the employer is to maintain **salaries** commensurate with the training and responsibility of his engineer employees. The problem of salaries, which is profession wide, can only be solved on such a basis. In civil engineering particularly, salaries are tied in with the fees paid to the consultant by his clients. Even the salaries of employee engineers in government employ are directly related to the salaries paid by private consultants. Consultants should cooperate with one another in establishing and maintaining fees that are reasonable and just for the work involved, and at the same time adequate to maintain employee salary scales.

The fourth responsibility of the employer is to provide **security of employment.** This, I believe, rightly belongs last as there is no such thing as complete employment security short of commitment for life in a prison. That type of guaranteed security is not for engineers. The responsibility for job security rests 90 percent of the time with the employee himself—in his own ability and in his own confidence that he can make good. Only those engineers who try to see how little they can give their employer and still get by need worry about security. Employees of this type are not and never will be engineers in the true professional sense; therefore we should not concern ourselves with them.

This comment is not meant to minimize the responsibility of the employer to provide reasonable security of employment for his capable engineer employees. Such employees should not have to look forward to prompt layoff every time clients become a little scarce or, in the case of government employees, whenever political considerations enter the picture. A true professional engineer cannot and will not be content to do nothing for any length of time. Therefore, I submit, if reasonable employment security is provided, the employer has performed his full duty to the truly professional engineer employee.

Economic recognition needed

During the past hundred years or so the exploitation of the worker has been the subject of many impassioned speeches and articles. Various solutions to this problem have been advocated and tried. Undoubtedly the most successful for those who work with their hands has been the labor union. Actually the engineer employee of today cannot be considered as exploited, although much needs to be done to raise his economic status.

Unionization and collective bargaining have been advocated as possible solutions to our economic and professional problems. Many of us feel that such a radical solution would be unethical; that members would lose their professional status, thus reducing the profession to the level of a trade; that the engineer's output would be standardized; and that in general his rugged individualism would be killed by such a move. Unionization would also tend to split the profession into employee and employer groups. The old adage, "United we stand, divided we fall," is very apt in this case.

The other solution that has been advocated is a strong centralized unity organization which would work toward improvement of the economic and professional status of the engineer regardless of whether he is an employee or an employer. A step towards such an organization on a national level was taken when Engineer's Joint Council (EJC) was formed. There are a number of noteworthy accomplishments to the credit of EJC such as the national law recognizing engineering as a profession and the water resources study made at the request of the Federal Government. However, engineers as individuals are probably more interested in seeing some immediate improvement in their economic status. Little has been done by EJC to improve this directly. Also EJC has not been equipped to handle local or regional problems. Another approach to the unity organization has been the professional society, which is organized at both local and national levels. Here again, little has been done to advance the economic status of the individual engineer.

There is no single or easy solution to the problem of raising the economic status of the engineering profession. However, we as a profession, composed of both employees and employers, should not cease to expend every effort to seek an answer to our economic difficulties.

There can be only one conclusion. When every individual engineer, employee or employer, meets his responsibilities on the highest level of integrity, then and only then will we attain our goal of a mutually satisfactory and profitable relationship between the engineer employee and his employer.

(This article is based on Mr. Lee's address at the ASCE Knoxville Convention, presented as part of the panel discussion on "Responsibilities of the Engineering Employer and Employee to Each Other," before the session sponsored by ASCE's Department of Conditions of Practice, with W. F. Moehlman, A.M. ASCE, as moderator.)

Brownlee Dam, being built by Idaho Power Company, will create 57½-mile lake on Snake River. River soon will be diverted through tunnel, and dam will rise 395 ft above foundation level. Project scheduled for completion late in 1958 will have generating capacity of 540,000 kw. Camp houses 800 construction workers.

Photo below:
City of Tacoma is building Mayfield Dam 20 miles east of Chehalis, Wash. Note old wood trestle which served Cowlitz, Chehalis & Cascade Railway. Access roads, batching plant, construction shops, and diversion tunnel are partially completed. This 160,000-kw project is first of two planned by Tacoma City Light on Cowlitz River. Second is 300,000-kw Mossyrock.

In the Tennessee Valley, practically all the important water resources projects have been constructed. Flood control, navigation, hydroelectric power, and other benefits that can be obtained from developed river resources are a reality. Since practically all the energy available from the rivers of the valley has been developed, future power requirements are being met by the construction of thermal-electric plants.

The Northwest, on the other hand, still has the greatest amount of undeveloped water resources in the United States. The Columbia River and its tributaries discharge into the ocean each year more than 180 million acre-ft of water. Of all the potential hydroelectric power in the United States, 40 percent is in the Northwest.

In the main control plan submitted by the Army Engineers, a total of 20,890,000 acre-ft of storage space was recommended to be made available to reduce the 1894 flood to a flow of 800,000 cfs. The 1894 flood is the highest of record, with a peak discharge of 1,240,000 cfs at The Dalles, Oreg. This location, 85 miles above Portland, is used as a point of reference for flood control. Of the total recommended storage space, the Army Engineers have reported that 4,890,000 acre-ft is available today. In other words, about 25 percent of the flood control protection planned from reservoir storage is now in operation.

Navigation is more fully developed but still requires, to complete the system, the construction of five multiple-purpose projects: the John Day Project on the Lower Columbia, and the Ice Harbor, Lower Monumental, Little Goose and Lower Granite projects on the Snake River. The estimated cost

Northwest river development gains from private power investment

E. ROBERT DE LUCCIA, M. ASCE, Vice President and Chief Engineer, Pacific Light & Power Co., Portland, Oreg.

Heavy equipment moving in steady stream cuts new channel for Lewis River, to permit clearing of site for Swift Dam in southwestern Washington. Later entire river will be diverted through tunnel of 32-ft diameter being driven nearly 3,000 ft through cliff on left bank. This hydro project will be Pacific Power & Light's third and largest on this river, and two more sites are being investigated upstream.

Photo below:
Earth-fill dam 323 ft high creates 10-mile lake which mirrors majestic Mt. St. Helens. Two large generators contribute capacity of 133,000 kw to Northwest Power Pool. Yale Dam is Pacific Power & Light Company's second largest hydro project on north fork of Lewis River.

of these projects totals about one billion dollars.

As for electric power, the situation is briefly as follows:

	Average	Peak
Maximum potential	19,000,000 kw	45,000,000 kw
Practical limit	12,500,000 kw	28,000,000 kw

In terms of the 28 million kw of peak, approximately 8 million kw is now in operation. Federal projects now under construction will provide an additional 3 million kw; non-federal projects for which licenses from the Federal Power Commission have been issued, and on which construction has or is about to be started, total 2,900,000 kw; applications for license pending before the Federal Power Commission total about 1,900,000 kw; projects now being investigated under preliminary permit

from the Federal Power Commission and in connection with legislative proposals, total slightly in excess of 3 million kw. Thus, a total of 19 million kw of the potential peak power is now in operation, under construction, or being seriously investigated. Even with this large effort, it is difficult to keep up with the growing power loads.

Over the past ten years, federal appropriations for new projects have totaled $1.5 billion. Within the next ten years, it is anticipated that $3 billion will be required for multiple-purpose developments to keep up with growing power loads. And for the five years after 1965, it is estimated that at least $2.5 billion will be required. In terms of annual requirements, in the past ten years an average of $150 million per year was spent. Average future needs are, for the next ten years, $300 million per year, and for the succeeding five years, $500 million per year. However stated, enormous amounts of money are required.

Local agencies assist

During the past ten years, while the Federal Government has been installing 3 million kw, both public and private agencies have been installing 2,400,000 kw of hydro capacity. Of the approximate 8,500,000 kw of capacity (hydro and thermal) now in operation in the Northwest, 4,150,000 kw is federally owned. Local non-federal agencies own 4,350,000 kw, of which about three-fourths belongs to private utilities.

The request of the present Administration that local agencies participate in the development of river basins wherever willing or able has met with whole-hearted response.

The Idaho Power Company, under a recent license from the Federal Power Commission, has commenced construction of a three-dam program on the Snake River in the Hells Canyon reach, relieving the Federal Government of the necessity of appropriating over $400 million and providing flood control storage, needed electric power, and other benefits without cost to the Federal Government or the taxpayer.

In the State of Washington, Congress deauthorized the Priest Rapids project, and the Federal Power Commission issued a license to the Grant County Public Utility District for its construction. To make this venture a success, with its installed capacity of 1,170,000 kw, all the private utilities and many of the public bodies in the area are underwriting it. The total estimated cost is $350 million, for which no Congressional appropriation is needed.

A bill has been introduced in Congress modifying the authorization of the 1,105,000-kw John Day project to permit participation by local public and private power agencies, allowing them to contribute $273 million of the total estimated cost of $310 million. For the navigation facilities, Congress would appropriate $37 million, and the project would be constructed and operated by the Army Engineers.

The Pacific Power & Light Company has offered to help expedite urgently needed flood control on the Middle Fork of the South Santiam River in Oregon by constructing the powerhouses for the Green Peter and White Bridge projects. The installed capacity would be 96,000 kw, and the company, in paying for the power facilities and that part of the joint costs allocated to power, would relieve the Federal Government of half the estimated project cost of $58 million.

The City of Eugene, Oreg., has offered to construct the power facilities for the Cougar project on the South Fork of the McKenzie River, Oregon, with an installed capacity of 35,000 kw, and pay over $11 million of the estimated $33 million cost.

Other projects reported on by government agencies, but not yet authorized by Congress, include the Pleasant Valley and Mountain Sheep projects on the Snake River below Hells Canyon, with plans for 1,183,000 kw at an estimated cost of $213 million. The Pacific Northwest Power Company (sponsored by the Montana Power Company, the Washington Water Power Company, the Portland General Electric Company, and the Pacific Power & Light Company) is seeking a license from the Federal Power Commission and has already spent nearly $2 million in investigations and plans on these projects.

The City of Tacoma has commenced construction of the Mayfield and Mossyrock developments with an installed capacity of 460,000 kw and an estimated cost of $146 million.

Portland General Electric Company has commenced construction of the Pelton project on the Deschutes River with an installed capacity of 120,000 kw at an estimated cost of $28 million. The Washington Water Power Company has started construction of Noxon Rapids project on the Clark Fork River in western Montana with an installed capacity of 400,000 kw at an estimated cost of about $80 million. Pacific Power & Light Company has begun construction of the Swift hydroelectric project on the Lewis River in the State of Washington with an installed capacity of 257,000 kw at an estimated cost of $59 million.

To summarize, since the Administration's invitation to local agencies to participate in the construction of projects as part of multiple-purpose river basin developments, in the Northwest there have been applications for preliminary permits or licenses to the Federal Power Commission and legislative proposals to Congress for some 30 projects totaling about 7,800,000 kw of installed capacity and estimated to cost about $2.3 billion, excluding transmission facilities. In many cases, preliminary permits and licenses have already been issued. Major transmission facilities are estimated to require another $500 million.

Thus local public and private agencies have joined together in developing the area. Development of one part of the region helps the development of other parts, regardless of ownership. It is recognized by all thoughtful persons that matching of non-federal with federal funds stretches out the federal dollar and permits construction of needed flood control, irrigation, and water conservation facilities at a faster rate.

There is no real necessity for the Federal Government to appropriate funds to meet growing electric power needs beyond completing those projects now under construction. And even in some of these, there are still opportunities for local financing of power features. The confusion and power shortages arising from attempts to keep up with increasing electric loads by constructing multiple-purpose river basin projects wholly with federal funds retards rather than increases the multiple-purpose development by slowing down construction. Actually, the people in the area are prevented from having sufficient electric power to meet growing loads, while urgently needed flood control, navigation, irrigation, and water conservation are delayed by diverting the major part of available federal funds to hydroelectric power. For the future, as in the past, multiple-purpose development in the Northwest must continue on a basis of cooperation between all agencies—federal, local public, and private.

Cooperation in operation

Nor is cooperation confined to financing and construction.

The Northwest Power Pool, commenced nearly 25 years ago by the private utilities in the area and expanded to include all power suppliers—federal, non-federal public, and private agencies—operates on a completely voluntary basis. Not a drop of water is wasted that can possibly be used to generate electric power. As a result of these coordinated operations, it is estimated that over 800,000 kw of capacity is made available over and above what would have been obtained without coordinated operation. This is the equivalent of one and one-half Bonneville

Dams. Flood control storage space is provided as needed and determined by the Army Engineers. Irrigation needs are carefully considered and provided for. Fish and wild life requirements receive careful consideration. Recreation facilities are made available.

Those who want the Federal Government to provide all electric power continue in their attempts to block projects that are not wholly constructed by the Government. They will not recognize the essentially cooperative spirit among local agencies; the large and ever increasing amounts of capital required; the need for faster construction; and the willingness of the local power agencies, public and private, to accept responsibility for power development. These are not matters for the political arena.

Storage possibilities yet remaining in the Columbia Basin, including Canada, are greater than required for economical firm power before thermal-electric power is installed in substantial amount, and a point of diminishing returns will be reached where additional storage will be uneconomic. These factors are now recognized by all concerned, and previously prepared plans for the multiple-purpose development of the Columbia River Basin are now actively being restudied.

The Northwest is not alone in its desire to take part in the construction and operation of multiple-purpose projects.

In the Southeast, Congress adopted legislation deauthorizing federal development of the Coosa River in Alabama. This development, which will be a fully coordinated multiple-purpose development under Federal Power Commission license and under the supervision of the Corps of Engineers, will cost in excess of $100 million and will be constructed by the Alabama Power Company without expense to the Federal Government.

Pacific Gas & Electric Company has offered to develop 130,000 kw of hydro power in connection with the Trinity River project in California which is being built primarily for irrigation and water supply, and thus avoid a $50 million Congressional appropriation.

A group of companies in New York State and also the State of New York have bills before Congress to further redevelop the United States part of the power potential at Niagara Falls at an estimated cost of $405 million without cost to the Federal Government. The added power would total 1,280,000 kw.

At the Yellowtail project in Montana, the Montana Power Company and Pacific Power & Light Company have offered jointly to construct the 200,000 kw of power facilities at this multiple-purpose irrigation, water conservation and power project and relieve Congress of a $51 million appropriation.

Construction speed-up needed

There is an increasing awareness that at the present rate of expenditures by the Federal Government, the existing backlog of authorized projects and those added in large number by every Congress will require several generations for completion. A speed-up is being demanded to give the people the protection of flood control, the advantages of navigation, the use of whatever electric power is economically associated therewith, and other benefits as soon as possible; and to minimize any adverse effects resulting from delays.

A good illustration of adverse effects due to delays is offered by the authorized Green Peter flood control project in Oregon, previously mentioned. In 1955 before a committee of Congress, farmers and other residents of the area testified with photographs and other supporting information that their farm lands were being rapidly eroded, and made an urgent plea that construction of the Green Peter Dam, on the South Santiam, a tributary of the Willamette, proceed as soon as possible. Further up the Willamette, completed flood-control dams were changing the regimen of the river so that flood flows which formerly produced relatively deep water and backed up into the South Santiam, were being held back and the flood waters of the South Santiam were running out into the Willamette at greatly increased velocities, thus aggravating flood damage. A committee of local citizens asked the Pacific Power & Light Company if there was any way in which it could assist in the matter. After careful investigation, the company offered to construct the power facilities and pay the joint costs properly allocated to power, and thus save Congress half the cost of the entire project.

There is a growing awareness in federal agencies of the need to expedite construction. The Division Engineer, Missouri River Division, Corps of Engineers, Brig. Gen. W. E. Potter, M. ASCE, stated in a talk in St. Louis in January of this year, that the Corps of Engineers has "unstarted or uncompleted projects totaling more than $8.5 billion . . . ." He pointed out that each of these projects had passed a searching discussion and critical scrutiny at all levels of review and represented a certified and unsatisfied need.

Other matters beside power receive the careful consideration of private utilities in the Northwest. For example, in connection with the investigation of the Mountain Sheep and Pleasant Valley dams in the lower end of the Hells Canyon section of the Snake River, the companies have provided funds to the Oregon Fish Commission, Oregon Game Commission, Idaho Fish and Game Commission, Washington Fish and Game Commissions, and U.S. Fish and Wildlife Service for a joint study of the fish and wild life resources that might be affected by these dams. These studies, now under way, are scheduled for completion so that conclusions which might affect construction will be available at the appropriate time. The companies involved have agreed to contribute up to $232,000 for these investigations. Similarly, the Idaho Power Company is making available about the same amount in connection with the Hells Canyon, Oxbow, and Brownlee dams upstream. Pacific Power & Light Company has agreed to make available for similar studies on the Lewis River in connection with the Swift hydroelectric project approximately $52,000 to the Washington Fish and Game Commissions and the U.S. Fish and Wildlife Service.

Sums of money are being given to appropriate agencies for the investigation of archeological and other treasures which might be inundated by flood waters. The companies are cooperating with the National Park Service, Forest Service, and State Forest and Recreation agencies to insure that recreational values will be protected.

The point is being rapidly reached where electric power developed as a consequence of multiple-purpose river basin development will become a smaller factor in supplying energy requirements. National issues resulting from such hydroelectric development will become of less importance. The local issues remaining will be related primarily to physical factors of local construction, operation, and availability.

I foresee no fundamental change in the design and construction of the physical works related to multiple-purpose river basin development. I note, among other things, the increasing consideration being given to water conservation for domestic and industrial uses. I suggest that, as opportunities for future hydroelectric power development become relatively smaller in terms of future requirements, the other water uses and conservation features will bulk proportionately larger. And finally, looking one step beyond, I see leaving the wings and impatiently coming onto the stage that newest of energy sources —the atom—with its many, many problems and opportunities.

(This article is a shortened form of the paper presented by Mr. De Luccia at the ASCE Knoxville Convention, in the Symposium on Multiple-Purpose River Development, before the General Technical session presided over by C. E. Blee, Chief Engineer of the TVA.)

SONIC METHOD proves valuable for testing concrete specimens

In the belief that some of the advanced methods being used for testing materials by industry today would prove valuable tools for the civil engineer, a study was undertaken by the writers in connection with their senior undergraduate work at Bucknell University. After some preliminary study, the sonic method was chosen as the most promising subject for more detailed investigation.

The original concept of sonic investigation in dense media came as an outgrowth of the work of Timoshenko[1] and W. P. Mason.[2] Mason investigated the work of Prof. Langevin, College de France, in the use of supersonic sound waves. Mason attempted to see what happened to these waves when they were passed through a dense media such as concrete. Using a small bar of concrete measuring 3 × 8 × 30 cm, and a set of bells whose frequency of vibration was known, Mason would strike the bar of concrete and then strike a bell. This was continued until, in Mason's estimation, they were in consonance. Then, since the frequency of the bell was known, the frequency of the concrete could be obtained.

This concept in itself was of little value, but concurrently Timoshenko[1] had made an abstract mathematical investigation of the relationships between the frequency of vibration of a solid and its modulus of elasticity. These two studies combined became the foundation of sonic testing of concrete and other solids to determine their moduli of elasticity.

The first real improvement in these methods was made by T. C. Powers,[3] who combined the two principles and improved the system. An oscillator whose frequency range was from 20 to 4,000 cycles per second was placed against a concrete bar (bars of various dimensions were used), and was allowed to oscillate through its complete range. At the other end of the concrete bar a crystal pickup was mounted and connected to a wave meter. When the oscillating frequency and the wave-meter frequency were the same, the concrete bar had reached one of its natural frequencies. This frequency was then used to calculate the modulus of elasticity. The one complication in this system was that there were an infinite number of natural frequencies, and it was not possible to detect the fundamental among all the others. A further complication was that certain of the harmonics gave wave-meter readings very close to, but not the same as, the fundamental frequency.

The next important step in developing the sonic method of testing was the introduction of the oscilliscope by Obert and Duval.[5] They reinvestigated the established theory and practical concepts of sonic testing of concrete specimens to determine their moduli of elasticity and established that, at the fundamental frequency, the Lissajous pattern appearing on the oscilliscope screen would be a perfect circle, and at the same time the maximum power would be consumed by the oscillator. (Lissajous patterns are more or less complicated closed curves, formed by the combination of two harmonic vibrations of different frequencies, but at right angles to each other.) This combination of circumstances removed the complications of the previous procedures. It made possible the identification of the fundamental frequency. In addition to the introduction of the oscilliscope, Obert and Duval went into a rigorous derivation of a formula to obtain Young's modulus for the concrete specimen.

The method is described by C. E. Goodell[6] as follows:

"The sonic method of testing is primarily one of determining the fundamental or natural frequency of vibration of a concrete specimen under consideration, the modulus of elasticity being related to this frequency by the following formula, $E = CWN^2$."

The derivation of the equation for Young's modulus of elasticity will not be dealt with here in its more rigorous form; instead the reader is referred to an article by Obert and Duval, reference No. 7 in the bibliography. In the formula, $E = CWN^2$, where E is the unknown Young's modulus of elasticity, the constant C is a function of the shape and density of the specimen; W is the weight of the sample in pounds; and N is the fundamental frequency of the sample.

The value of C can be found from the relationship,

$$C = \frac{4\pi^2 I^3 T}{gIM}$$

where I is the moment of inertia about the X-X axis; M is the mode of vibration (equal to 1 for the first mode); T is a constant involving Poisson's ratio; and g is the acceleration due to gravity.

For a cylinder (Fig. 1), this equation is reduced to:

$$C = 0.0041632 \frac{l^3}{d^3} T$$

From this it can be seen that the problem resolves itself into two basic operations: (1) to determine the fundamental frequency, and (2) to use the formula, $E = CWN^2$. To get the fundamental frequency, we make use of the oscilliscope pattern (the Lissajous figure) and the power consumed by the driver, in micro amps. Although the fundamental theory involved is somewhat complicated, it can be understood by use of the simple principles of sound and vibration learned in physics. We know that if a vibration is impinged on another body it will set up sympathetic

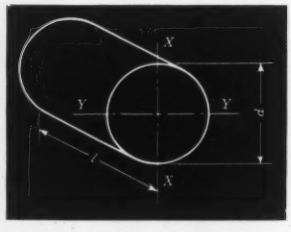

FIG. 1. Cylinder for derivation of equation, $E = CWN^2$.

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vibrations in that body. These vibrations that are set up or induced are a function of the impinging vibration and the density of the media of the second body. It is also known that each material or combination of materials has a fundamental frequency of vibration. This is the lowest vibration level that the material will reach when sufficient energy is available to cause it to vibrate at a frequency equal to

$$N = \frac{k}{2I}\sqrt{\frac{t}{u}},$$

where N is the lowest natural frequency of vibration or the fundamental frequency; k, a constant of shape and size; I, the moment of inertia; t, the thickness of the section through the X-X axis; and u, Poisson's ratio.

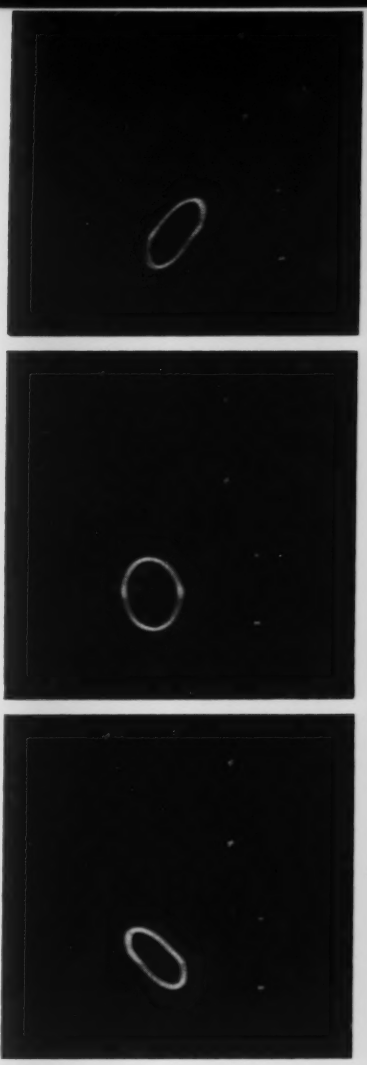
If more than this energy is received, the frequency will remain unchanged. To measure this fundamental frequency, we take advantage of another fact, that when two bodies are vibrating at the same frequency and amplitude, with their vibrations in quadrature and at right angles, they will give a distinctive Lissajous figure on the oscilliscope. This pattern is a circle.

As the frequency of vibration is varied, the oscilliscope screen is observed. When the proper Lissajous pattern, a circle, is observed, and when the power to the driving oscillator is at a maximum, a reading of the frequency is recorded. This is the fundamental frequency of vibration, the frequency N needed to evaluate $E = CWN^2$.

The electro sonometer was used to perform the test work. The sonometer was coupled to a DuMont dual-beam oscilliscope in order to get the Lissajous patterns. The electro sonometer is a self-contained set consisting of a power source to drive a modified Hewlett-Packard type 200 BR oscillator, the driver, a crystal pickup system, amplifiers to amplify the signal generated in the test specimen, and a resonance indicator. This kit also contains all the necessary cables and plugs to make the coupling to the oscilliscope. See Fig. 2.

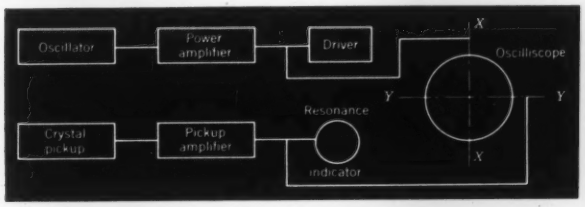
The samples were mounted on steel knife edges at the quarter points, and the driver was placed against one end of the sample and the pickup at the other end. Two men were needed to make a test to assure ease and accuracy in observing the oscilliscope and the deflection of the resonance indicator.

One of the experimental conditions that had to be resolved was the method of supporting the test sample (Fig. 3). Various supports were tried. Obert and Duval[8] recommended that the samples be placed on a soft rubber support. In attempting to duplicate this specification, we experienced extreme difficulty. The samples, being round, tended to pull away from the driver. This had to be held in firm contact with the sample or some of the energy of vibration was dissipated and incorrect results were obtained.



At fundamental frequency of model, Lissajous pattern on oscilliscope screen is perfect circle. In top view, pattern approaches resonance; in middle view, it is at resonance; at bottom, past resonance.

Our group first tried using a piece of hard rubber tubing. This method of support gave good results but it was still difficult to keep the specimen tight against the driver. Next we tried soft wood (pine) knife edges, which were



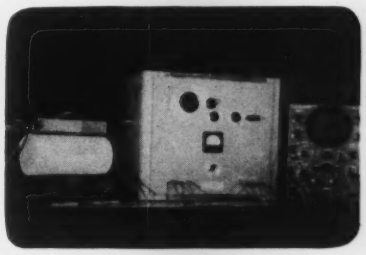


FIG. 2. Setup of electro sonometer, with main components of test apparatus, is seen in diagram and photograph.

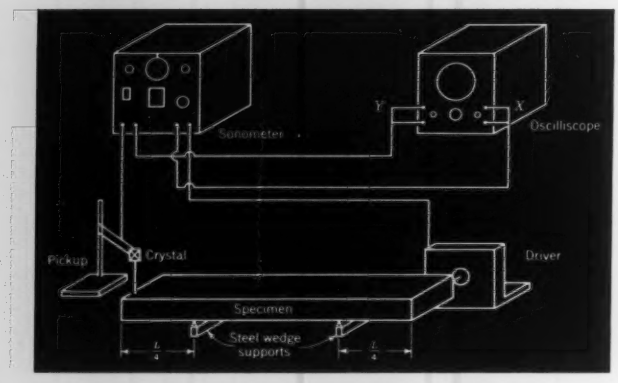


FIG. 3. Diagram shows sonometer set-up with rectangular specimen.

completely unsatisfactory. The second or third sample dulled the knife edges and the results were not accurate. A combination of sponge rubber and wooden blocks was next used. These also proved unsatisfactory. The last and finally successful method was the use of steel knife edges. These edges gave firm support to the test cylinder and could be wedged so as to maintain firm contact between the driver and the test sample. This method of support was then used for all the experimental work, as shown in Fig. 4.

In the studies by our group, we limited our samples to 6 × 12-in. concrete cylinders. These were samples of commercial concrete being placed at several locations near Lewisburg, which were sent to the university to be tested to assure that they met the contract specifications. The samples were both 7-day and 28-day, that had been moist cured in the Civil Engineering Laboratory.

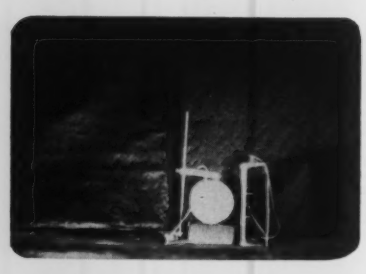
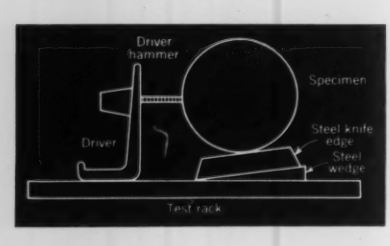


FIG. 4. Steel knife edge, with wedge, keeps cylindrical concrete specimen tight against hammer of driver.



The testing procedure was as follows. The samples were removed from the moist curing room and capped with a cement and plaster of Paris mixture. After the caps had hardened the samples were carefully weighed, then placed in the sonometer support rack, and the fundamental frequency was determined. From this the modulus of elasticity was calculated by use of the formula, $E = CWN^2$.

After the sonometer determinations, the samples were placed in a Universal testing machine and loaded to failure. From the testing-machine results, the compressive strengths in pounds per square inch were determined. Using the rule-of-thumb that the modulus of elasticity divided by one thousand is approximately equal to the compressive strength in pounds per square inch, the strength of the samples was also calculated from the sonometer results. These two strengths were then compared to establish the reliability of the sonometer.

The results of these experiments were, in general, in good agreement. The compressive strength of any given cylinder was approximately the same in both methods of testing. The sonometer results were, in general, somewhat higher than the results secured from the Universal testing machine. This was anticipated since Obert and Duval[8] and T. C. Powers[4] had shown that the dynamic method of testing (sonic) gave E_0, Young's modulus, at no load while the testing machine gave E_1, or Young's modulus, as a function of some load.

Two other considerations must be mentioned: (1) the effect of capping with the cement and plaster of Paris mixture, and (2) the use of the rule-of-thumb for finding the compressive strength at failure by dividing the modulus of elasticity by 1,000.

The effect of the use of the capping mixture is most easily evaluated. In a comprehensive report found in the *British Concrete Journal*,[9] the effect of caps of many different materials is tabulated. It is shown that the capping mixture used reduces the final compressive strength of the sample tested in a conventional testing machine by as much as 250 psi. If this correction is added to the values obtained from the testing machine, they tend to close the gap and give closer correlation between the two methods.

To evaluate the effect due to the use of the rule-of-thumb, we used a compressometer on three cylinders selected at random. The compressometer results were plotted and the true tangent modulus of elasticity and the compressive strength were calculated. It was found that dividing the modulus of elasticity by 1,000 to obtain the compressive strength was not accurate and that an average value of 900 was more nearly correct.

When both of these corrections were applied to our results, the two methods of testing agreed within 3 percent. These results are presented in the form of graphs. The first graph, Fig. 5, entitled "correlation curve," shows the agreement between the two methods of testing with no corrections, and indicates that the agreement between the two testing procedures lies within the 15 percent found by T. C. Powers.[4] The second graph, Fig. 6, entitled "corrected correlation curve," shows the marked agreement between the two methods and tends to establish the reliability of the sonic method of testing. The other three graphs (Fig. 7) are stress-strain curves for the three selected samples used to determine the actual relationship between modulus of elasticity and compressive strength. These curves follow the accepted method of computing the modulus of elasticity and need no further explanation.

In reaching conclusions, our group has taken into consideration the great amount of work done by others, as we feel that our study merely complements theirs, rather than adding something new. Our work shows that the sonometer test does give accurate results in computing the compressive strength of concrete samples. Further, this test is simple to do, is fast in operation, and reduces the chance of errors to a minimum. Another striking advantage is that the test equipment is completely mobile. Thus it can be taken to any place where the tests can most conveniently be made. This is a distinct advantage over the testing machine, which cannot be moved. As a note of

interest, it is mentioned that the equipment can easily be transported in a Ford station wagon with a three-man crew.

At this point one might ask, "What is the practical importance of this type of testing?" The answer is that this type of testing falls under the heading of non-destructive testing, that is, the sample is not modified or destroyed in the course of the tests. Non-destructive tests are an important tool of the engineer. They permit him to reach sound conclusions as to the strength and quality of a concrete structure without expensive waste of materials for testing. An adaptation of the equipment used in this series of experiments makes it possible to accurately estimate the strength of existing structures as much as 50 ft thick. Another advantage of the non-destructive test is that if an error is made in the procedure, the sample can be retested, since it is intact.

Studies now under way are in reality just a continuation of this same work with the electro sonometer. Here we are using the same basic technique as has been described, and the same formula, $E = CWN^2$. As has been mentioned, the term C involves the shape and density of the specimen being tested, or in other words contains a function of the length and the moment of inertia. Since length can be easily evaluated by measurement, and since the modulus of elasticity can be evaluated with the sonometer, the moment of inertia can become the unknown in the equation. In this study we have been using rectangular concrete beams and evaluating I, the moment of inertia. Since the moment of inertia of a rectangular solid is easily calculated, we have had a constant check on our experimental results. To date, these results have shown very good agreement. It is intended to continue this study to include standard rolled sections of steel and aluminum, and to compare their handbook values with our experimental results.

The value of this work lies in the fact that calculating the moment of inertia for certain complicated geometric configurations is extremely difficult and often must be approximated. By using the sonic method of testing, the moment of inertia can be solved for directly, no matter what shape or geometric configuration the sample may take. Examination of concrete blocks with from one to three holes has been completed and for them the theory has proved reliable. A special application would prove most helpful in the study of stresses in the honeycomb sections now standard in the aircraft industry.

The tests here described were carried out in the Civil Engineering Laboratory of Bucknell University under the direction of Carl Kindig, Professor of Civil Engineering.

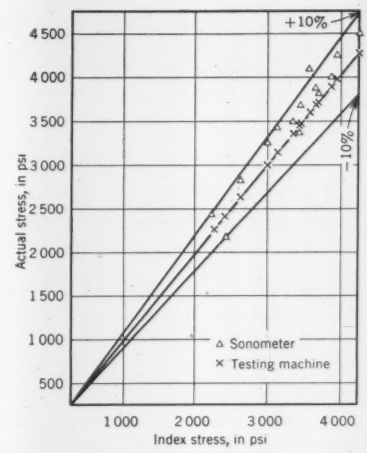


FIG. 5. Correlation curve shows agreement within 15 percent obtained between testing-machine and sonometer results before application of correction factors.

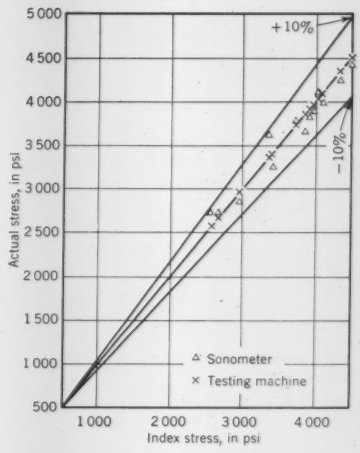


FIG. 6. After application of correction factors, correlation curve shows agreement within 3 percent between testing-machine and sonometer results.

(This article was the winning paper in the contest at the 18th annual Philadelphia–Lehigh Valley Student Chapter Conference held at Princeton University on April 23, 1956.)

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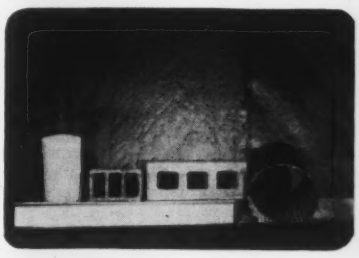


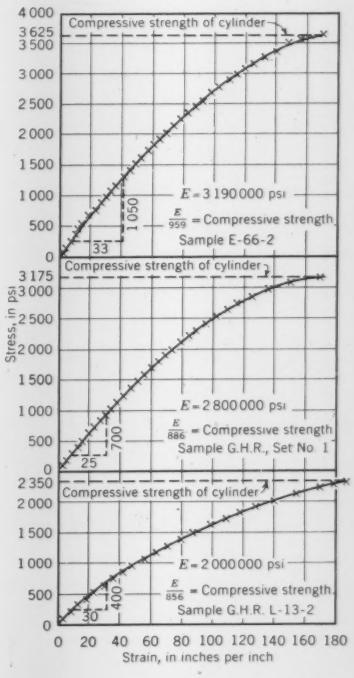

Compressive strength of cylinder
E = 3 190 000 psi
E/959 = Compressive strength
Sample E-66-2
Compressive strength of cylinder
E = 2 800 000 psi
E/886 = Compressive strength
Sample G.H.R., Set No. 1
Compressive strength of cylinder
E = 2 000 000 psi
E/856 = Compressive strength
Sample G.H.R. L-13-2
Stress, in psi
Strain, in inches per inch

FIG. 7. Stress-strain curves are shown for the three selected samples used to determine actual relationship between modulus of elasticity and compressive strength (Nov. 1955–Jan. 1956).

With sonic methods of testing, moment of inertia can be solved for directly, no matter what shape sample may take. Some of the samples for which moment of inertia was found by sonic method are pictured.

Two useful gages measure bolt tension and slip in a joint

R. L. SANKS, M. ASCE, Assistant Professor of Civil Engineering, University of Utah, Salt Lake City, Utah

Two gages designed specifically for a research project on high tensile bolted joints have proved so satisfactory that other engineers may find in them the answer to similar measuring problems.

Load cells

The load cell of Fig. 1 was developed to measure the tension in bolts. Any measuring device used for this purpose must be small, and should be as short as possible so that the strain characteristics of the bolt are not too greatly changed. Some sort of device is required for high accuracy because the bolts are stressed beyond the elastic limit, and strain measurements of the bolts are subject to the errors of creep and lack of uniformity in materials and heat treatment. The load cell in place is shown in the accompanying photo.

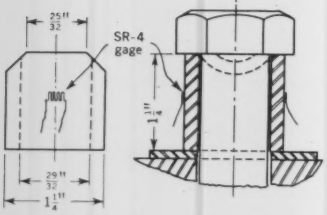


FIG. 1. Load cell measures tension in a bolt. In photo, cell and clip gages are seen in place on a bolted joint.

One end of the load cell was beveled to reduce the effects of non-uniform bearing. At full load, the beveled end indents the bolt head slightly, giving a uniform bearing pressure and preventing variable stress concentrations from affecting the SR-4 strain gage adversely. At the specified bolt tension (32,400 lb for a $^{7}/_{8}$-in. bolt), the strains in the SR-4 strain gage are high (about 3,000 micro-inches per inch); so the load cell is quite sensitive and responsive. Because the load cell is fairly deep with respect to its diameter, it is quite stiff, and the distribution of bearing pressure on the washer must be virtually the same as that which would be produced by direct contact between bolt head and washer.

These load cells were made of SAE 4135 steel heat-treated to Rockwell C-54, but a better steel would be 52,100 heat-treated to Rockwell C-60. Two type A-8, SR-4 gages were cemented to each load cell with Armstrong Epoxy Resin A-1 glue (made by Armstrong Products Inc., Warsaw, Ind.). Dummy gages were applied to another piece of steel. More recently, better results were obtained with AB-11 (bakelite) SR-4 gages. An added advantage is that these gages can, when cemented with hard de Khotinsky cement, be easily removed and used again.

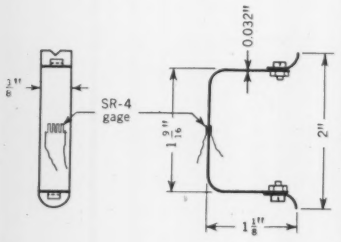


FIG. 2. Clip gages measure slip in a joint.

The load cells were calibrated in a Southwark Tate-Emery 60,000-lb universal testing machine. Strains were read with a Baldwin Type K strain indicator. Both concentric and eccentric loads were applied; in the latter the bearing plate was tipped approximately one degree in several directions. Of nine load cells, two were erratic (with deviations up to nearly 5 percent), but the greatest deviation in any test (including eccentric load tests) on any of the other cells was 2.6 percent. Below design loads, erratic behavior might be expected, but although tests at lower loads were limited, and therefore inconclusive, the cells behaved surprisingly well.

Clip gages

The clip gages shown in Fig. 2 were used in pairs to measure the slip of the joint. By means of the "harness" shown in the photograph, the clip gage measured the relative displacement of the center pin with respect to the outside pins, thus reducing to a minimum lost motion and the errors due to strains in the plates. Dial gages are commonly used for this purpose, but they are bulky, slow to read, and much less convenient to mount.

The clip gages were made of phosphor bronze bent cold. The versatility of the clip gage was increased by making separate "feet" and bolting them to the gage. The gage can be quickly converted to other purposes by changing the "feet." By making the bolt holes oversize, it is possible to adjust

the "feet" so that the sensitivity of a number of gages can be matched. The sensing elements were two type A-8, SR-4 gages cemented with epoxy resin to each clip gage and connected in such a way that one gage acted as an active temperature compensator.

The SR-4 gages were connected to an Ellis BAM-1 meter (Ellis Associates, Box 65, Pelham, N.Y.). This meter is direct reading (no balancing is required), and the sensitivity can be varied as desired; therefore data can be recorded directly in final form, and no reductions or calculations are necessary. During the first part of a test on a bolted joint, the meter was set to read directly to $^1/_{10,000}$ in. Then, when slip became large, the meter was reset to a lower sensitivity to read directly to $^1/_{1000}$ in., thereby increasing the range. The system was convenient, quick, and accurate. Response was linear over a deflection of plus or minus 0.15 in. The overall error of clip gage and meter seldom exceeded one least reading and never exceeded two least readings—that is, $^2/_{10,000}$ in. in the $^1/_{10,000}$-in. range. Thus the maximum error was somewhat less than 2 percent of the range used.

The writer had hoped, when he conceived the ideas for these gages, that errors would be less than 10 percent. The accuracies reported here seem rather unbelievable but are what the data show.

Actually, neither gage is wholly new. Many experimenters have used heavy, large-diameter tubing for lead cells, but so far as the writer knows, no one has ever reported cells used for this purpose, although other systems have been developed in attempts to measure load in bolts. The beveled end on this load cell appears to be the key to its performance, and this at least is wholly new.

Semicircular or arched clip gages have been used for years for rough measurements, but their response is not linear. By making a rectangular "rigid frame" and by putting a little reverse bend in the clip gages—so that when they are flexed to spring them into position the gage is straight—the accuracy becomes excellent. Again the writer has no knowledge of similar devices used for precision tests.

The research project referred to here was sponsored by the American Institute of Steel Construction and conducted by the Department of Civil Engineering, University of Utah, under the direction of the writer. C. C. Rampton, Jr., made most of the tests; other student assistants were C. M. Skoubye and L. R. Lamb. C. R. Davis helped prepare the drawings. Assistance received from the University research fund is hereby acknowledged.

THE READERS WRITE

"Three-dimensional" design for Bhakra Dam

TO THE EDITOR: The article on the construction of India's 700-ft-high Bhakra Dam, by M. H. Slocum and B. R. Palta, in your August issue, should be of interest not only to dam builders but also to design engineers. Selection of the type of structure most suited to a particular dam site and stress analysis of the adopted high dam are of far greater importance than in the case of a medium-sized structure.

Extensive three-dimensional stress and stability analyses, considering five different loading combinations, were carried out before the final gravity section was adopted for Bhakra Dam. The writer was associated with the three final studies for the dam, which were based on the Trial-Load Twist Method developed by the U. S. Bureau of Reclamation.

Bhakra Dam is located in a wide V-shaped canyon. The dam site is narrow enough for an arch dam. This type of dam, however, lost out in favor of the straight gravity type because of comparatively poor rock in parts of the abutments. It was decided that, in the design of the gravity section proper, advantage should be taken of the influence of the shape of the dam site on the stability of such a structure. A "three-dimensional" structure, which disperses and transfers in all directions the forces acting against it, was therefore preferred over a cantilever gravity dam, which transfers these forces only vertically to the foundations of individual blocks.

All transverse contraction joints in the dam are formed with vertical interlocking keys. These joints are to be sealed with grout when sufficiently open and when the reservoir water level is close to the top of the spillway crest. It was determined by the analytical studies that the most opportune time to grout these joints will be when the reservoir level is as high as can possibly be maintained, since this condition will reduce tensile horizontal normal stresses on transverse planes through the dam. As long as the transverse contraction joints are not grouted, the dam will act as a hinged "three-dimensional" structure. It was therefore necessary to check its stability as a hinged structure also.

The advantage of designing and building Bhakra Dam as a "three-dimensional" gravity structure can be judged by comparing shear-friction factors of safety at the base of the maximum section, obtained for conditions combining maximum reservoir level and unfavorable horizontal and vertical earthquake acceleration. For a cantilever gravity section, the factor was 3.24; for the hinged gravity dam, it was 5.62; and for a monolithic structure (transverse joints grouted), it further improved to 6.47. As a cantilever gravity dam, the adopted section would be considered too thin and unsafe, as the shear-friction factor is less than four. However, the "three-dimensional" dam would be considered adequately stable.

Lowest shear-friction factors in a "three-dimensional" straight gravity dam do not occur at the base of the maximum section, but are instead located on the inclined abutment planes. For Bhakra Dam, the lowest shear-friction factors on abutment planes, for the loading conditions previously described, were 4.23 for the hinged structure, and 3.99 for the monolithic dam. For the cantilever section, the factor at the same location was 6.73. These factors occur at a height of about 350 ft above the lowest foundation of the dam. Three-dimensional behavior, therefore, not only indicates the sufficiency of a thinner section, but also the favorable adjustment of stability factors at various locations in the dam.

Another interesting feature included in these analyses was the effect of the longitudinal contraction-joint grouting program on the vertical stresses in the dam. The result was a non-linear distribution of these stresses, which seems to corroborate the results obtained from strain meters embedded in Shasta Dam and other gravity structures.

G. S. SARKARIA, J. M. ASCE
Engineer, International Engineering Co.
San Francisco, Calif.

SOCIETY NEWS

Pittsburgh Convention—A Success

For the second time since 1881 an Annual Convention of the Society has been held away from the headquarters city, New York. Our Pittsburgh Section was the host—a gracious and generous host, too—for an outstanding week-long convention centered in the Penn-Sheraton Hotel on Mellon Square. More than a hundred members of the Section served on the Annual Convention Committees, of which Park H. Martin, Hon. M. ASCE, was general chairman.

President Enoch Needles (right) congratulates Mason Lockwood on his inauguration as 88th President of ASCE.

The Convention opened on Monday, October 15, and continued through Friday, October 19, with sessions of the Board of Direction, and meetings of upward of 70 committees of Technical Divisions, the Department of Conditions of Practice, and committees dealing with special tasks held both before and after these dates.

The attendance reached 1,650, which included several hundred students and their Faculty Advisers. The presence of members from China, Japan, the Philippine Islands, Hawaii, Italy, Panama, Venezuela and, of course, Canada, Alaska, and the 48 states is indication of the widespread interest in the Convention.

Official Welcome to Pittsburgh

The Hon. David L. Lawrence, three-term mayor of Pittsburgh, declared by official proclamation the week of the convention to be Civil Engineers Week. In his welcoming address he reminded his listeners that Pittsburgh was "discovered" by a surveyor—an engineer, who became the first president of the United States. What Pittsburgh is today, he said, is due to the work of civil engineers. What has been accomplished in relieving traffic congestion, reducing smoke, disposing of municipal waste, reducing flood damage, and providing off-street parking, bridges, express highways, tunnels, and fine buildings has brought about a renaissance in Pittsburgh, in large part the work of civil engineers. Pittsburghers have reason to be proud of the fact that their civic and industrial leaders have accomplished so much, in face of the recommendation of a well known planner who stated years ago, "all you can do with Pittsburgh is to abandon it."

During the Convention more than 200 papers of broad technical and professional interest were presented in the thirteen Technical Division and Department of Conditions of Practice sessions. The capable chairman of the technical program was Carl B. Jansen, M. ASCE.

Hon. David E. Lawrence, mayor of Pittsburgh, signs document proclaiming Convention week to be Civil Engineers Week. Looking on are President Lockwood; Park H. Martin, Hon. M. ASCE and general chairman of Convention; and Sara-ann Lance, J.M. ASCE, member of Registration and Information Committee. Proclamation—presented by Allegheny Conference on Community Development—was prominent in a window display featuring the work of civil engineers.

Each session was arranged by a Division program chairman, and each had a presiding officer and a monitor. At breakfast each day these authors, chairmen, presiding officers, and monitors for the day's sessions met together to coordinate their day's work to assure smooth operation under the guiding hand of Wilfred Bauknight, vice-chairman of the technical program committee. Authors' breakfasts are now standard Convention procedure, and very useful they have proved to be.

Highway Building

Papers by experts on the rebuilding of the Convention city constituted an important part of the technical program. Of major interest, also, was an excellently coordinated nine-part symposium, entitled "Expressway Problems Unlimited," put on by the Highway Division under the guidance of James W. McKnight.

At a joint luncheon of the Highway, Soil Mechanics and Foundations, and Surveying and Mapping Divisions, Rex M. Whitton, M. ASCE, president of the AASHO, extolled the multi-billion-dollar Federal-aid highway bill as one that "undoubtedly will go down in our history books as the most forward-looking and far-reaching legislation ever enacted in this nation." At this luncheon Bertram D. Tallamy, M. ASCE, chairman of the New York Thruway Authority, just named by President Eisenhower to become new Federal Highway Administrator, was introduced. Mr. Whitton told the meeting, "Mr. Tallamy is the best man in the United States for the job. There is none better." Earlier in the week the ASCE Board of Direction had telegraphed to the President and to Secretary Weeks approving and commending the appointment of Mr. Tallamy.

Top officers of ASCE (left to right in upper view) are Norman Moore, Vice-President, Zone III; Francis Friel, Vice-President, Zone II; Mason Lockwood, President; Enoch Needles, Past-President; Glenn W. Holcomb, Vice-President, Zone IV; Frank A. Marston, Vice-President, Zone I; and Executive Secretary William H. Wisely. Bottom photo shows big delegation from Texas Section, which flew to Pittsburgh to see Mason Lockwood inaugurated as the first President of the Society from their state. Mr. Lockwood (holding the flag) is flanked on his right by his charming wife, Past-President Needles, and Executive Secretary Wisely.

Nuclear Power in Our Future

A variety of phases of the production of electric power from nuclear reactors, the disposal of atomic waste, and the design of containment structures for power reactors were on the programs of several Divisions. General interest in atomic power was evidenced by the four-bus-load inspection party that viewed the 60,000-kw nuclear power plant—the first full-scale atomic power station in the country—which is under construction for the AEC and the Duquesne Light Company at Shippingport, Pa., 35 miles west of the city.

An "Appraisal of Atomic Power" was the subject of a luncheon address, by C. V. Roseberry, manager of the Westinghouse Electric Corporation's commercial atomic power activities. Mr. Roseberry pointed out that, in spite of the current great and world-wide activity in nuclear energy, "King Coal and Queen Oil are not even close to abdicating their thrones." When and where atomic energy will be competitive with conventional sources of power, he said, no one can say yet; not until we have had operating experience with full-scale reactors. Great Britain's Calder Hall atomic energy plant, he noted, has just begun producing power (page 85). Mr. Roseberry directed attention to the fact that about one-half the present high cost of an atomic plant involves civil engineering work.

Three informative Convention articles on the Shippingport Plant appeared in the October issue, and Mr. Roseberry's address is scheduled for early publication.

Civil Construction by Corps of Engineers

Many speakers represented the Corps of Engineers, the U. S. Bureau of Public Roads, the U. S. Public Health Service, the Atomic Energy Commission, and the states of Delaware, Missouri, and Pennsylvania. Others were engineer officials of industrial corporations and partners in consulting offices. From the Corps of Engineers came Maj. Gen. Emerson C. Itschner, M. ASCE, Chief of Engineers, who addressed the Civil Works Luncheon sponsored jointly by the Construction, Hydraulics, and Waterways and Harbors Divisions. To emphasize the character of the civil works conducted by the Corps,

C. V. Roseberry (left-hand view), of Westinghouse Corp., explains operation of a scale model of the fuel element core of a nuclear reactor. In photo at right, General Itschner, Chief of Engineers, expresses pleasure that 25 engineers of the Corps are presenting papers at the Convention. With him are Col. H. E. Sprague, C. M. Wellons, and Col. R. E. Smyser.

General Itschner pointed out that "At this Convention . . . Corps personnel are presenting papers before six different Divisions —25 papers in all—covering such varied topics as military bridging, navigation facilities, Arctic transportation, hurricanes, flood control, stilling basins, grouting, cavitation, and public organizations." He added that the Corps encourages its engineers to become ASCE members and to take active part in its program. Speaking on the subject, "Tomorrow's Demands Will Be Greater," he emphasized that "our nation possesses tremendous but undeveloped resources of engineering talent . . . Our most serious problems are not technical ones . . . Engineering is more than . . . plans, specifications and field work." In order to meet the greater demands of tomorrow, he concluded that "The engineering profession must be, more than it has been, a full participating member in all aspects of modern society."

The Earth Satellite

What is the much publicized earth satellite made of? How is it to be launched? How long will it stay aloft? How big and how heavy is it? What instrumentation will it carry? Answers to these and similar questions were given in words and illustrations by James S. Kirkpatrick, whose firm is engaged in fabricating the satellite, in a paper presented before the Construction Division. Watch for this article in a coming issue.

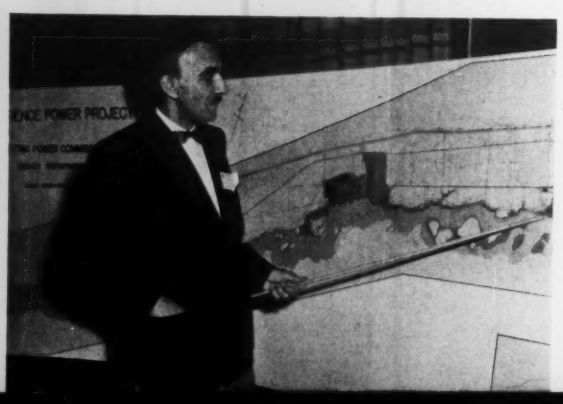
How to Get Good Public Relations

A symposium on "The Civil Engineer and his Public Relations," headed by ASCE Vice-President Frank Weaver, retiring chairman of the Department of Conditions of Practice, attracted much attention. For five years ASCE has enjoyed and appreciated the services of Charles M. Bayer, public relations consultant. As one of the panel he pointed out that public relations is neither sinister propaganda nor magic. Instead it "is an effort to earn the appreciation of folks and to develop and maintain that appreciation . . . so that they will hold you in high esteem when they know the facts." Some Local Sections have effectively told newspaper editors and broadcast directors what civil engineering has done for their community. Editors are becoming eager to record engineering accomplishments. "When all 74 Local Sections are seized with an ecstacy . . . . to shout out the story of civil engineering to newspaper editors, the result will be a pleasing reward to the profession for the time and effort devoted."

Philadelphia Section President V. G. Thomassen told an amazing story of what his Local Section is accomplishing toward bringing engineering works to favorable public notice. In a forthcoming CIVIL ENGINEERING article, Mr. Thomassen will outline the Section's public relations program and the resultant rewards.

One of the rewards of understanding the needs of a newspaper editor was a full first page in the Pittsburgh *Sun-Telegraph's* 8-star edition for October 18, which extolled the Convention and the contribution of civil engineers in words and pictures.

In view at left W. H. Williams, chief surveyor of the Hydro Electric Power Commission of Ontario, Toronto, discusses Ontario's survey program for St. Lawrence project. Highway Division group (shown at right) includes Bertram Tallamy, new Federal Highway Administrator; E. H. Karrer, chairman of the executive committee of the Highway Division; and Rex M. Whitton, chief engineer of the Missouri State Highway Commission and president of the AASHO.



Upward of 50 Technical Division committees met before, during, and after the Convention to plan their year's work. Here is the Highway Division's Committee on Geometrics of Highway Design. Seated, left to right, are R. L. Fisher, D. W. Loutzenheiser, and C. H. Lang; standing are E. F. Passarelli and M. J. Madigan.

Awards and Installations

At the Annual Business Meeting, on October 17, Executive Secretary Wisely called attention to the Board of Direction's Annual Report, distributed to those in attendance this year in an attractive new dress. He said that as soon as the detailed financial statement has been completed, certified and printed, copies of the informative report, complete with the financial statement, will be mailed to every member of the Society. "While the report chronicles only one year of accomplishment in the Society's second century of service," he stated with certainty that "these accomplishments are the product of years of devoted effort and application by thousands of ASCE members."

Outgoing President Enoch R. Needles made a brief report of his year of stewardship. "I was proud of my Society when I took office," he admitted. "After twelve months, my pride . . . is beyond all bounds and words of expression. Your Board of Direction, your Executive Secretary and his staff, your Local Section officers, and the heads of all your Divisions and committees are all wonderful workers in your behalf . . . Thanks to them and to your members, our Society was never sounder, healthier, or more productive.

"During the year I have been privileged to meet with representatives of over 60 of our Student Chapters and 25 or 30 of our Local Sections from Maine to California, and from South Dakota to Alabama. I have met with our Sections in Puerto Rico, Hawaii, and Mexico City. If our Society is not in a strong and increasingly healthy condition, I have met with the wrong people."

In a colorful ceremony the winners of the awards and prizes for superior contributions to the Society's publications were presented by Publication Committee Chairman Samuel B. Morris to President Needles, who conferred the several coveted honors upon them. These awards and the names of the recipients were published in the October issue. Because of the inability of Dr. Serge Leliavsky, M. ASCE, of Egypt, to be present to receive his award in person, arrangement had been made with the British Institution of Civil Engineers to present the J. C. Stevens Award to him during a professional visit to London. This was done at a special meeting of the Institution on September 14 (page 76).

Convention spark-plugs, Park H. Martin and Carl B. Jansen, and tireless hostesses, Mrs. Park H. Martin and Mrs. George W. Richardson, were responsible for smooth-running Convention operations.

In right-hand photo Admiral Ben Moreell accepts John Fritz Medal from Past-President Terrell. President Lockwood and Past-President Glidden look on approvingly.

Over 300 students and Faculty Advisers from 30 engineering schools attended the Convention. One of the big groups was a delegation of seniors from Cooper Union in New York City.

The Weather

PITTSBURGH
Sun-Telegraph

8-STAR EDITION

THURSDAY, OCTOBER 18, 1956 — FIVE CENTS

New ASCE Head Lauds 'Eminence in Engineering

Anxiety Felt Over 'Bids' For Young Talent

"Pittsburgh Sun-Telegraph" put out a special 8-Star Edition to mark the Convention.

In an equally solemn ceremony the new officers for 1957 were inducted. Installed as Vice-Presidents to serve for two years were Francis S. Friel, of Philadelphia, and Norman R. Moore of Vicksburg, Miss. Six new Directors were also inducted into office, each for a three-year term. They are Randle B. Alexander, Austin, Tex.; E. Leland Durkee, Bethlehem, Pa.; Clinton D. Hanover, Jr., New York City; William J. Hedley, St. Louis; Finley B. Laverty, Pasadena; and Howard F. Peckworth, Chicago.

A high point in the morning session was the inauguration of the Pipeline Division, which grew out of the Construction Division's Committee on Pipelines. Eldon V. Hunt, M. ASCE, Alberta, Canada, was named chairman of the executive committee of the new Division, and J. B. Spangler, its secretary.

President Lockwood Installed

President Mason G. Lockwood, of Houston, Tex., presented his carefully documented inaugural address before a standing-room-only audience. His address, which is of interest to every member of the Society, is reproduced in its entirety in this issue. Among the numerous points he keynoted as parts of his plan of action for ASCE during the coming year, he said, "There is concern [among our Section officers] which I share, over the inadequate compensation received by the vast body of engineers and engineering educators with from five to fifteen years of experience, whose income has not kept pace with everything around them." The basis of his address was a questionnaire to all Section officers. As might be expected, a big delegation from the Texas Section flew in to greet the first President of ASCE from Texas and to attend his inauguration.

At the Annual Membership Luncheon on Wednesday the Society's highest and most coveted honor, that of honorary membership, was conferred on five members: George W. Burpee, Albert Haertlein, Gen. Thomas M. Robins, Ole Singstad, and Ralph B. Wiley. Featured luncheon speaker was I. W. Wilson, the engineer president of the Aluminum Company of America, who discussed the responsibility of the engineer to his community. He cited his own city of Pittsburgh to show that engineers are and can be successful in civic life. "Very little of our redevelopment could have been accomplished without the skill of the engineering profession," he asserted. "Certainly the dramatic changes that have taken place here are tributes to the vision of many of our leading citizens, but," Mr. Wilson added, "they are also monuments to the professional engineers who—both in public and private capacity—contributed their talent to transform ideas into reality."

At the Society's banquet Admiral Ben Moreell, Hon. M. ASCE, chairman of the Board of the Jones and Laughlin Steel Corp., received the John Fritz Medal, awarded jointly by the four Founder Societies. The award was made for Admiral Moreell's achievements as a "distinguished engineer and noted officer, builder of Naval works in war and in peace, eminent industrialist and civic leader, devoted servant of church and country."

Student Participation

Upward of 300 students from 30 Student Chapters attended the convention. Special housing facilities and privileges were provided by the Student Activities Committee, headed by Prof. John W. Graham, Jr., A.M. ASCE, recently named as vice-president of Cooper Union. In a morning-long conference on Thursday, an impressive panel of five practicing engineers addressed the students on the live subject of "The Next Five Years" from the viewpoint of men prominent in public works, in construction, in consulting practice, in education and research, and in industry. Past-President Needles and President Lockwood addressed the students at luncheon, after which they separated to take part in one of three field trips to inspect nearby industrial and civic developments. On Friday a score of Faculty Advisers met in all-day session to develop programs of Chapter activities for the coming year, and to hear from Executive Secretary Wisely, and his staff assistant, Allen P. Richmond.

Ladies Entertained

The ladies were included with their menfolk in several brilliant social affairs. In addition, while the men were involved in more technical activities, the ladies enjoyed their own program arranged by their gracious Pittsburgh hostesses. In charge of the women's activities were the indefatigable Mrs. George S. Richardson and Mrs. Park H. Martin. A visit to the University of Pittsburgh's "Cathedral of Learning," a luncheon at the University Club and another at the Longue Vue Country Club, a Cinerama matinee, and a boat trip on the three rivers rounded out a program that the visiting ladies will remember with pleasure for a long time.

Literally hundreds of members contributed of their time and talents for more than a year to make the Convention possible and then to run it without visible hitch. To these modest men the Society is greatly indebted. Special thanks go to Park H. Martin, general chairman; to Prof. F. T. Mavis, his vice-chairman; to Director George S. Richardson, in whose district and city the Convention was held; and to Elio D'Appolonia, president of the Pittsburgh Section.

Most of the pictures here shown were taken by Paul A. Parisi, J. M. ASCE, editor of ASCE Technical Publications.

New Board of Direction in session in Pittsburgh has full agenda of work. Seated (beginning left and proceeding clockwise around table) are: Executive Secretary William H. Wisely; President Mason Lockwood; Past-President W. Roy Glidden; Director Carey H. Brown; Director Mason C. Prichard; Director Howard F. Peckworth (behind Lockwood); Director R. Robinson Rowe (N. G. Neare); Director Graham P. Willoughby (behind Prichard); Treasurer Charles E. Trout; Director Jewell Garrelts; Past-President E. R. Needles; Director Don M. Corbett; Director Randle B. Alexander; Director Clarence L. Eckel; Vice-President Francis S. Friel; Vice-President Norman R. Moore; Director Frederick H. Paulson; Vice-President Glenn W. Holcomb; and Vice-President Frank A. Marston. Standing, left to right, are: Director Louis E. Rydell; Director Lawrence A. Elsener; Director Robert H. Sherlock; Director John P. Riley; Director William J. Hedley; Director E. Leland Durkee; and Director Finley B. Laverty. Directors Clinton D. Hanover and George S. Richardson were absent when the photo was taken.

What the Board Did at Pittsburgh

A full agenda faced the Board of Direction at its meetings at the Penn-Sheraton Hotel, Pittsburgh, during the Annual Convention. Some of the more important actions taken by the Board are briefed here.

Conventions and Meetings

Conventions. An ASCE Convention is scheduled for Chicago February 24–28, 1958, with headquarters in the Hotel Sherman. A Convention is also planned for Los Angeles, February 8–13, 1959, with headquarters in the Hotel Statler. The Hotel Cleveland has been selected as headquarters for the Cleveland Convention, which is being held May 4–8, 1959.

Local Section Conferences. A new procedure is scheduled for Local Section Conferences in 1957. Instead of meeting during Convention week, the conferences will be held in four places next year in conjunction with:

1. The Pacific Southwest Council, San José, Calif., April 30–May 1, 1957.
2. The Pacific Northwest Council, Walla Walla, Wash., April or May 1957.
3. The annual meeting of the District 3 Council, or the New England Council.
4. The annual meeting of the District 7 Council.

The Committee on Conditions of Practice will meet in Cincinnati, Ohio, August 10–11, 1957, in conjunction with the annual meeting of the District 9 Council and a meeting of the Executive Committee of the Board of Direction.

The Technical Procedures Conference is scheduled for Oklahoma City, April 12–13, 1957.

Meetings of the *Executive Committee* of the Board are set as follows:

1. Mobile, Ala., with the Alabama Section, December 7, 1956.
2. Walla Walla, Wash., with the Pacific Northwest Council, April or May, 1957.
3. Cincinnati, Ohio, with the District 9 Council and the Committee on Conditions of Practice, August 9, 1957.

Federal Highway Administrator

Telegrams were sent to President Eisenhower and Secretary of Commerce Weeks, approving and commending the appointment of Bertram D. Tallamy, M. ASCE, as Federal Highway Administrator. See the "News Briefs" department of this issue for more details of Mr. Tallamy's appointment.

Committee on Conditions of Practice

On recommendation of the Committee on Conditions of Practice, of which Vice-President Frank Weaver is chairman, the Board took the following action:

1. Authorized the production of a brochure about the civil engineering profession, to be prepared by the Committee on Engineering Education, with the intent of interesting and informing junior and senior high school students, and their teachers and parents.

2. Named an educator to the ASCE-AGC Joint Cooperative Committee.

3. Approved appointment of a task committee of five members, including representation from the Committee on Professional Practice and the Committee on Professional Conduct, to formulate a statement of principles of professional practice. It is intended that these principles, when prepared and approved, shall supplement the Code of Ethics.

4. Endorsed in principle the proposal of the Committee on Salaries for the establishment of a continuing Salary Index, to be maintained and published under the guidance of the Committee on Salaries.

5. Approved the appointment to the Committee on Professional Practice of four non-Board members. This action will expand the Committee to nine members, including the contact member from the Board.

6. Adopted as a minimum standard program for the Department of Conditions of Practice at all Conventions, at least one luncheon, during which no other Convention activity will be scheduled, and one additional session.

Prizes and Awards

Research Prizes

The 1956 Research Prizes were awarded to

1. Fred Burggraf, M. ASCE, director of the Highway Research Board, Washington, D. C., in recognition of his outstanding contributions to knowledge through the administration of research in highway engineering and construction materials.

2. Chester P. Siess, M. ASCE, research professor of civil engineering at the University of Illinois, in recognition of outstanding contributions to knowledge through his research on reinforced concrete slabs.

3. Vinton W. Bacon, M. ASCE, executive officer of the California State Water Pollution Control Board, Sacramento, Calif., in recognition of achievements in applied research on waste water reclamation, pollution, and water quality.

Daniel Mead Prizes

The Daniel Mead Prize for Junior Members was awarded to Robert A. Schaack, J.M. ASCE, Burbank, Calif., for his paper on "Responsibilities of the Architectural Firm and the Engineering Firm on a Cooperative Undertaking."

The Daniel Mead Prize for Students was awarded to James M. Anderson, of Swarthmore College, for his paper, "Ethics of the Senior in Making Commitments with Prospective Employers."

Harza Latin-American Junior Member Award

In 1945, the late L. F. Harza, M. ASCE, presented $1,600 to the Society, with the request that the fund and the income from it be used to pay the entrance fee, first year's dues as a Junior Member, and the cost of a Society badge to a qualified young graduate of a Latin-American University. The seventh award has been granted to José Luis Arizti Garay, a graduate of the School of Engineering of the University of Mexico.

Publications Policy

The advent of Division Journals caused the Committee on Publications to recommend a restatement of policy with respect to the publications of the Society. This statement of basic publication policy, as approved by the Board, will be published in the December issue.

Engineering Center

A Task Committee on the Engineering Societies Center was authorized by the Board at its July 10 meeting. The committee consists of Past-President Daniel V. Terrell (chairman), G. W. Burpee, C. B. Molineaux, Past-President R. E. Dougherty, F. A. Marston, and Director J. P. Riley (contact member), with W. H. Wisely to serve as secretary. Messrs. Terrell, Burpee, and Molineaux are ASCE's representatives on UET.

United Engineering Trustees has authorized $40,000 and the American Institute of Chemical Engineers $10,000 for a preliminary study by a firm of architects and engineers of the relative costs and advantages of: (1) Remodeling the present Engineering Societies Building; (2) constructing a new building on the same site; or (3) building on another mid-town site.

Negotiations with the AIChE, looking toward that Society's membership in UET, are underway.

Pilot Survey of Engineering Profession

An appropriation not to exceed $15,000 was approved for the pilot survey of the civil engineering profession, to be made by the Society's Task Committee on Engineering Education.

The Board also endorsed the joint ECPD-EJC survey of the whole engineering profession, and voted a sum not to exceed $10,000 toward the $50,000 fund needed for the preliminary work on this profession-wide survey.

Engineers Joint Council

The Board announced its approval of the application of the American Society of Heating and Air-Conditioning Engineers (ASHAE) for constituent membership in EJC.

ASHAE was founded in 1894 and is incorporated in the State of New York. A majority of its 6,360 voting members meet the requirements of the EJC Constitution. In addition, as of January 1, 1956, it also had 3,938 non-voting members.

Voluntary Fund

The Board appointed a standing committee of its members to act as trustees of the Voluntary Fund to explore all proper uses of it and to report to the Board. The Voluntary Fund was established in 1947, and consists of voluntary contributions from members to establish a dependable cash reserve to be used for purposes determined by the Board. In 1952 about $9,900 of this Fund was used for organization expenses of the Centennial Convention in Chicago. At the end of the fiscal year the Fund stood at $66,500.

Highway Division

The Highway Division's Executive Committee was authorized to explore the establishment of a working liaison with the American Association of State Highway Officials.

Engineering Manpower Commission

The Board received a report from the Society's representative on EJC's Engineering Manpower Commission, Past-President Gail Hathaway. The report will appear in a subsequent issue.

Convention Policy and Practice

On the recommendation of the Task Committee on Convention Policy and Practice the Board approved:

1. A survey, to be conducted by the Executive Secretary, of potential exhibitors to determine the extent of their interest in participating in exhibitions during Society conventions. All the exhibit space scheduled for the Annual Convention, to be held in New York in October of 1957, has been reserved.

2. An appropriation not to exceed $5,000 to cover authorized overhead expenses in connection with the 1957 conventions.

ASCE Budget

The 1957 operating budget, totaling $1,358,761, was approved.

Shortridge Hardesty Memorial Resolution

The great loss to the Society and to the engineering profession in the death, on October 15, of Shortridge Hardesty, Hon. M. ASCE, was recorded, and expressions of sympathy were transmitted to his family.

Appreciation to Convention Personnel

The Executive Secretary was directed to transmit appropriate expressions of thanks and appreciation to all committees and individuals who contributed to the outstanding success of the Pittsburgh Convention.

ASCE MEMBERSHIP AS OF OCTOBER 9, 1956

Members	9,263
Associate Members	12,109
Junior Members	17,570
Affiliates	72
Honorary Members	46
Total	39,060
(Oct. 10, last year	38,254)

Plans for Jackson Convention Pushed

Committees of Mid-South Section members are already deeply involved in the Society's Spring Convention, which will be held in Jackson, Miss., February 18–22, with the Section as host. As the capital of the state, as one of the historic cities of the South, and as the center of a fast-growing industrial area, Jackson is an ideal convention city. We are promised, too, that February temperatures there are mild, with a strong feeling of spring in the air.

Established as the capital in 1821, Jackson was first named LeFleur's Bluff, after an early keel-boat trader, but the name was soon changed to Jackson in honor of Andrew Jackson, popular military hero of the day. During the War between the States most of the city was destroyed as an incident in the Vicksburg Campaign. Recovery was slow, and by 1900 the population did not exceed 7,000. Today, only 56 years later, the population is 122,000, much of this growth having been concentrated in the decade between 1940 and 1950. Some 60 new plants have been built there in the past decade.

Today Jackson is called the crossroads of the South. It is located on three major highways (U. S. 49, 51, and 80), and is serviced by two railroads (the Illinois Central System and the Gulf, Mobile, and Ohio Railroad Co.) and two airlines (Delta Air Lines and Southern Airways). Four major hotels—including the Heidelberg, official Convention headquarters—assure ample accommodations for the visiting engineers.

There is much to see in the city and its surrounding area. Probably of greatest interest to engineers will be the extensive installations of the Corps of Engineers Waterways Experiment Station, which include a model of the Mississippi River Basin, largest of its kind in the world. The city itself is notable for Battlefield Park, which contains original fortifications and cannons, and the Old Capitol, City Hall, and the Governor's Mansion, all over 100 years old. There will also be opportunities to see the ante-bellum homes in Natchez, the Vicksburg National Military Park, and a section of the famous Natchez Trace parkway.

Another drawing card is the proximity of the Mississippi Gulf Coast, called the "Riviera of America." This semi-tropical playground offers the longest known artificial beach (subject of a Knoxville Convention paper) and all the recreational attractions of a modern seaside resort. Those seeking a quieter vacation will be lured by the scenic beauty, historic landmarks, and restful climate of the Deep South. The "Seven Cities by the Sea"—Pascagoula, Ocean Springs, Biloxi, Gulfport, Long Beach, Pass Christian, and Bay St. Louis—offer the finest possible accommodations at surprisingly moderate rates.

Planning for the Jackson Convention is under the general supervision of Sydney W. Chandler, of Biggs, Weir and Chandler, Jackson. The many details are being resolved by numerous committees with representation from all over the Mid-South Section, which takes in the states of Mississippi, Arkansas, and the Memphis Area in Tennessee. The Technical Program Committee is headed by W. J. Turnbull, of the Waterways Experiment Station in Vicksburg. Although several details of the technical program remain to be completed, the information now available promises numerous varied and significant sessions. The full program will be published in a later issue.

The Department of Conditions of Practice will have two sessions with emphasis on youth. Glenn W. Holcomb, ASCE Vice-President for Zone IV and chairman of the Department of Conditions of Practice, will preside. Elmer K. Timby, of the New York firm of Howard, Needles, Tammen and Bergendorf, will be moderator for a panel discussion on "How to Attract Suitable High School Students to the Civil Engineering Profession."

The Hydraulics Division is scheduling five technical sessions, and its Committee on Research plans a session on Hydraulic Research for Large Dams. Among other papers on spillways and outlet works will be one by Rex A. Elder, of the Tennessee Valley Authority, Norris, Tenn., and Fred R. Brown, of the Corps of Engineers, Vicksburg. A session on Aerated Flow Research will include a paper by Lorenz G. Straub, of the University of Minnesota, Minneapolis, Minn. A valuable contribution, entitled "Wind Field and Surface and Bottom Stresses," will be presented by Garbis A. Keulegan in the session on Tidal Hydraulics.

The Structural Division will also have several interesting sessions, including a program sponsored by the Committee on Bridge Loadings. Prof. R. B. Peck, of the University of Illinois, will present a paper on soil pressures on bridge abutments and retaining walls, and J. M. Biggs, of Massachusetts Institute of Technology, will give a paper on vibration in single-span bridges.

Highway Division sessions will cover problems of highway planning, the expanded highway program, and control of access. There will also be several sessions and a luncheon under sponsorship of the new Pipeline Division. The Sanitary Engineering, Soil Mechanics, and Waterways and Harbors Divisions are among the other Divisions with interesting programs on the agenda.

Entertainment for the ladies will include a special luncheon and tour of Jackson on the 19th, a tea at the Governor's Mansion on the 20th, a visit to the Vicksburg battle ground on the 21st, including a luncheon at the famous Old Southern Tea Room, and finally a joint visit with the men to the Waterways Experiment Station.

Spacious and beautiful Jackson, the Society's Spring Convention city, combines Southern landmarks with modern industrial development. This shows the City Hall and Gardens.

Mexico City Is Host to Fourth UPADI Convention

His Excellency, President Adolfo Ruiz Cortinez of Mexico, addressed 200 representatives of engineering societies from sixteen North, Central, and South American countries in attendance at the Fourth Convention of the Pan-American Union of Engineering Societies (UPADI) held in Mexico City, October 8–12. "The people and the government of Mexico," President Cortinez said at the opening session on October 8, "note with deep satisfaction that the social problems of the people of the Americas will receive the preferential attention of this engineering Congress." He observed that technology and science must possess a social and human spirit, not merely search for scientific solutions to problems. The keynote of the Congress was the opportunity and the responsibility of the engineering profession in each country for constructive service to its citizens.

Host for the Convention was the Union of Mexican Associations of Engineers (UMAI) whose president, Miguel A. Mantilla, also presided over the convention. Meetings were held in the beautiful new building that houses the Secretariat of Communications and Public Works.

The convention urged that formal sessions on engineering education be held during future UPADI conventions; that scholarships be made available to engineers for study in other countries; and that technical institutes be established for technicians and foremen. The need for organizations creating national standards was noted. Delegations from Canada and the United States were asked to secure adoption of the metric system in their respective countries.

A round-table discussion on atomic energy was a highlight of the convention, and attracted many of the delegates. Dr. Clark Goodman, of the U. S. Atomic Energy Commission, reaffirmed his country's policy of sharing its knowledge of peaceful applications of atomic energy with its Latin American neighbors. The convention urged the Western Hemisphere countries to draw up uniform legislation on atomic energy and provide for complete exchange of information on the availability of raw materials.

At the round-table discussion of engineering education, which was conducted by Dean Lee H. Johnson, M. ASCE, of the Tulane University School of Engineering, the following five general areas of agreement were developed on which to base future activity in this field:

1. The need to employ full-time professors of engineering at attractive salaries.
2. The need to develop engineering education as a joint responsibility of industry and government.
3. The need to study basic requirements in engineering curricula and facilities.
4. The need to include a program for engineering educators for the next convention of UPADI.
5. The need to form a UPADI Committee on Engineering Education to function between conventions.

At the closing ceremonies, the United States delegation gave wrist watches to three Latin American engineers in recognition of their contributions to UPADI. Recipients were Luis Giannattasio, president of UPADI; Miguel A. Mantilla, president of UMAI; and Luis Giorgi, M. ASCE, U. S. alternate on the Board of Directors in Montevideo.

Among actions taken by the delegates was the election of Uruguay, Panama, and Ecuador to the Board of Directors. Montevideo was again selected as the location for UPADI headquarters, and Montreal for the 1958 convention.

President Cortines, of Mexico (hand raised) addresses Fourth Convention of UPADI in Mexico City. With him are Communications Secretary Walter C. Buchanan; Carlos Ulloa, director, Federal Electricity Commission; Miguel A. Mantilla, presiding officer of the convention; Eduardo Chavez, secretary of Hydraulic Resources; Hector Cassigne, secretary, UMAI; and Luis Giannattasio, president of UPADI.

Part of the U.S. delegation attending UPADI Convention includes, left to right, Mrs. Brandow; George E. Brandow, Mrs. Wisely; W. H. Wisely, Executive Secretary, ASCE; Walter E. Lobo, AIChE; Franklin Van Antwerpen, secretary, AIChE.

The following countries sent delegates representing the member engineering societies of UPADI: Argentine, Union of Argentine Associations of Engineers; Brazil, Federation of Brazilian Associations of Engineers; Canada, Engineering Institute of Canada; Chile, Institute of Engineers of Chile; Costa Rica, College of Engineers of Costa Rica; Cuba, Cuban Society of Engineers; Ecuador, Ecuadorean Society of Engineers and Architects; El Salvador, Salvadorian Society of Engineers; Guatemala, Engineering Association of Guatemala; Haiti, Haitian Association of Engineers and Architects; Mexico, Union of Mexican Associations of Engineers; Panama, Society of Engineers and Architects of Panama; Puerto Rico, College of Engineers, Architects, and Agricultural Engineers; United States, Engineers Joint Council; and Uruguay, Association of Engineers of Uruguay.

Among the EJC delegates were the following members of ASCE: President E. R. Needles, Past-President Gail A. Hathaway, Director Samuel B. Morris, Secretary Emeritus W. N. Carey, Executive Secretary W. H. Wisely, J. W. Barker (also President of ASME), Dr. Lee H. Johnson, George E. Brandow, Jacob Feld, Adolph Ackerman (vice-President of the Convention) and Stewart E. Reimel, secretary of the EJC Committee on International Relations.

Gail Hathaway, chairman of EJC Committee on International Relations, presents wrist watch to UPADI Convention President Miguel A. Mantilla. At left is James M. Todd, chairman, U. S. Delegation; in right background, Stewart A. Reimel, secretary, EJC Committee on International Relations; and at right Walter E. Lobo.

Questions About ASCE Catastrophe Coverage Answered

As of August 1 additional insurance benefits were made available to members under a new optional plan, called Catastrophe Hospital and Surgical (July issue, page 74). Later a circular letter, providing full details and enclosing application blanks, was mailed to the membership. In response to numerous requests for further information that have been received Smith and Sternau, administrators of the Society's group insurance plans, have made available this list of the questions most commonly asked, with their answers.

1. *Q.* How does the new Catastrophe coverage differ from the old Hospital and Surgical coverage?

A. This new coverage offers much broader benefits and much greater protection than the old Hospital and Surgical coverage. Here is a brief outline of what you receive in Catastrophe Hospital-Nurse-Surgical Coverage: Up to $5,000 for hospital room and board (up to $15 per day); 75 percent of miscellaneous hospital expenses; 75 percent of expenses actually incurred for the services of a graduate or licensed nurse rendered in the hospital or in the home after hospital confinement; and from $5.00 up to $500 for surgery.

2. *Q.* Who is eligible to apply?

A. During the initial enrollment period (until November 1, 1956), all members up to age 70 may apply. After that date, the maximum age for applicants will be 60 although the contract can be carried to age 70.

3. *Q.* Can my wife and children be covered under the new plan?

A. No, not at this time, but the Society is looking into the matter and dependent coverage will probably be offered very shortly.

4. *Q.* Does Catastrophe Coverage pay if I have Blue Cross and/or an individual policy which also pays my bills?

A. Yes, it pays *in addition* to and regardless of any other insurance you may carry or other source of indemnity.

5. *Q.* After I have used $5,000 for some particular sickness, can I ever collect on that particular sickness again?

A. Yes. If you have gone for a period of 12 months without any expense which would have been covered by the Catastrophe coverage, then you would again be entitled to $5,000 for this sickness.

6. *Q.* If I had used $5,000 for one particular sickness or accident, and then should develop another sickness, or have another accident, am I entitled to $5,000 for each sickness or each accident?

A. Yes.

7. *Q.* Is this coverage limited to the continental United States?

A. No, it covers you anywhere in the world.

8. *Q.* Are airplane accidents covered?

A. Yes, regardless of the type of flight or type of plane.

9. *Q.* What is not covered?

A. War, military service, pregnancy, mental disorders, and services rendered by any Federal Government hospital. That is all.

10. *Q.* How do the Catastrophe rates compare with coverage which I can acquire on an individual basis?

A. These rates are lower because the group-buying power of the Society affords a considerable saving to each member.

11. *Q.* Are the rates the same for all ages?

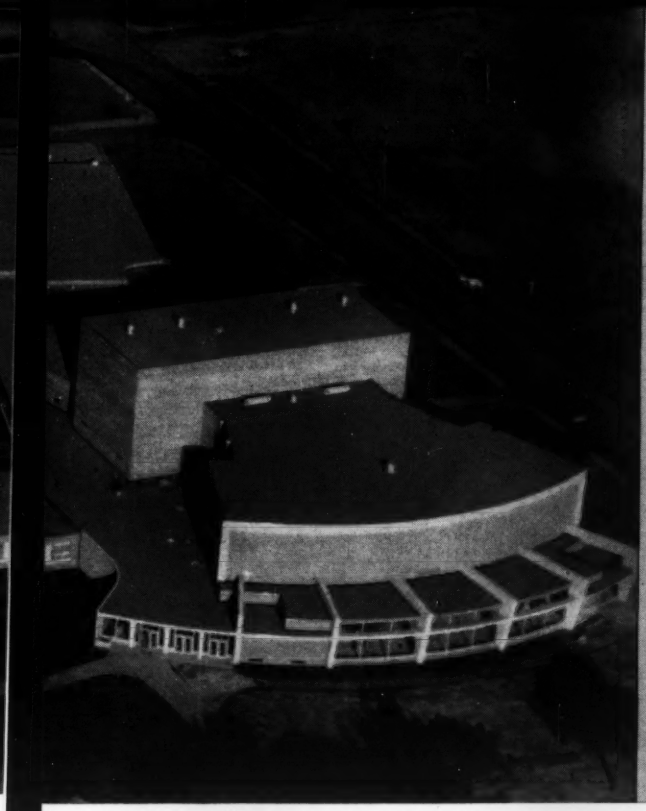
A. No. The rate varies according to age, and changes at ten-year intervals after age 50. It is believed this is the most equitable basis for these rates, since it is a recognized fact that as a person gets older medical expenses increase considerably.

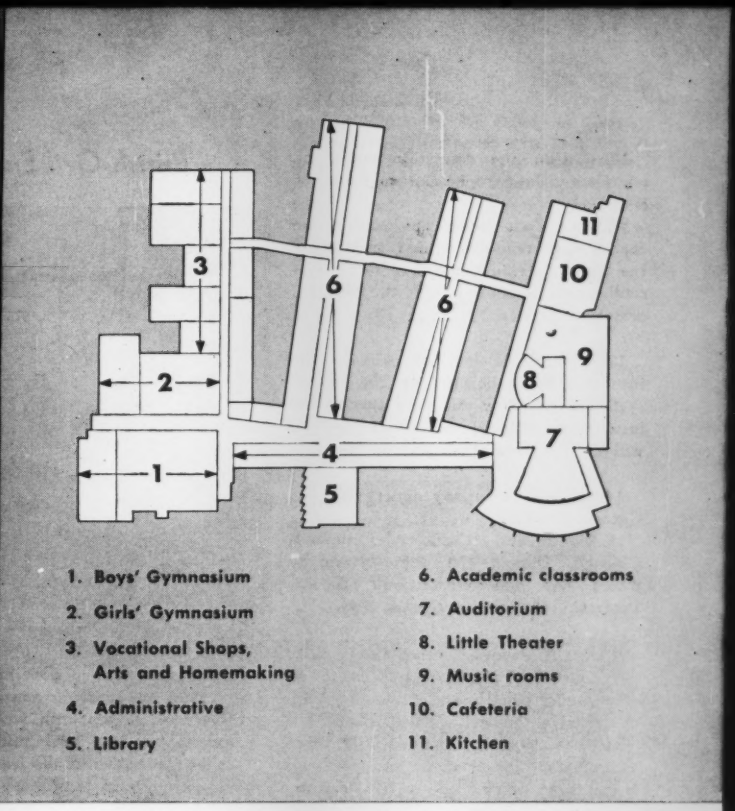
SENIOR HIGH SCHOOL, GRAND ISLAND, NEBRASKA. *Architect:* McNett, Stanage & Company, Grand Island. *General Contractor:* H. S. Holtze Construction Company, Sioux City, Iowa. *Steel Fabricator:* Paxton & Vierling Steel Company, Omaha, Nebraska.

Functional, economical "finger plan" of Grand Island

THE STRUCTURAL STEEL FRAMEWORK NEARING COMPLETION. Starting date for the school was October, 1953, and it was completed in July, 1955. Total cost of the school was $2,622,795.00.

UNITED STATES STEEL





1. Boys' Gymnasium
2. Girls' Gymnasium
3. Vocational Shops, Arts and Homemaking
4. Administrative
5. Library
6. Academic classrooms
7. Auditorium
8. Little Theater
9. Music rooms
10. Cafeteria
11. Kitchen

High School *again illustrates versatility of Structural Steel!*

The basic design of the new senior high school in Grand Island, Nebraska, consists of four "fingers," or wings, containing classrooms, radiating from a main administrative area. The "fingers," which extend toward the west, are oriented at slightly different angles from each other in order to secure the best lighting and ventilating situations. And, in addition to being connected to the administration area, each "finger" is joined to the others by means of a corridor—for quick passage from one wing to another. The school is sized to accommodate approximately 1,400 students. All areas are of one-story construction.

The unique building houses two gymnasiums, one of which will seat 2,600 spectators for varsity basketball games. The main auditorium will accommodate 1,500 people comfortably, and the Little Theater can seat 300. In both, stages are equipped to handle even the most intricate of productions. The ultramodern cafeteria, which turns out 600 to 700 meals with ease during the short lunch period, may be converted quickly into a study hall through the use of motorized rolling doors. The whole effect of the school is one of efficiency coupled with luxury. Yet, it was built at a cost of only $10.96 per square foot.

Approximately 1,017 tons of Structural Steel were used in the framework of the new building—contributing greatly to the economy of construction. As is usually the case, when economy must go hand-in-hand with imaginative architectural ideas, Structural Steel is called upon. And why not? Structural Steel is versatile. It's the strongest, most economical of load-carrying materials—effectively resists tension, torsion, compression and shear. Once enclosed in buildings, it lasts indefinitely, requiring no maintenance.

Structural Steel may be riveted, bolted or welded, and may be erected in any weather. And since steel members are fabricated indoors, weather can have no effect on the quality of workmanship. For further details, return the coupon.

USS STRUCTURAL STEEL

UNITED STATES STEEL CORPORATION, PITTSBURGH
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO
TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA.
UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

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Please send me a free copy of **Hot Rolled Carbon Steel Shapes and Plates,** *containing weights, sizes, and dimensions of the complete range of structural materials.*

NAME .....

COMPANY .....

ADDRESS .....

CITY ..... STATE .....

12. *Q.* Can the company cancel or restrict my Catastrophe Coverage after it is issued?

A. No. Your certificate cannot be cancelled or renewal refused as long as the Society's plan remains in force, you retain your membership in the Society, or until you retire or reach age 70.

13. *Q.* Are the benefits paid to the insured or to the hospital and the doctor?

A. The company will pay either to the insured or, if the insured authorizes it, will pay the hospital or doctor.

14. *Q.* What company underwrites the Catastrophe Plan?

A. Continental Casualty Company, Chicago, Illinois—the same company which has underwritten our Income Protection Plan since August 1, 1949.

15. *Q.* How does the new Catastrophe coverage affect the benefits I could receive under the Income Protection Plan described on the back of the brochure?

A. The Income Protection Plan provides benefits whether you are or are not hospitalized when you are disabled by accident or illness. Income Protection is a protective padding for your income when you are unable to perform the duties of your occupation. This Plan pays you weekly benefits and also provides lump-sum payments for accidental death and dismemberment. Income Protection benefits are payable regardless of any other insurance you may carry and are also payable in addition to the benefits under the new Catastrophe Plan.

16. *Q.* Is the new Catastrophe coverage offered in conjunction with Income Protection or may it be carried separately?

A. Members can apply for Catastrophe Coverage whether they are or are not enrolled in one of the Plans of Income Protection. A separate certificate is issued to the eligible members who apply.

17. *Q.* How does the new Catastrophe coverage affect the benefits I could receive under the old Hospital and Surgical Plan?

A. The old Hospital and Surgical Coverage is still available to members who carry Income Protection but CANNOT be carried at the same time as the new Catastrophe Hospital-Nurse-Surgical coverage.

18. *Q.* How do I apply for the new Catastrophe coverage?

A. Fill out the application which is part of the red brochure sent you and mail it in the enclosed envelope together with your check to cover your first annual or semiannual payment (depending on your choice).

British Civil Engineers Honor ASCE Prize Winner

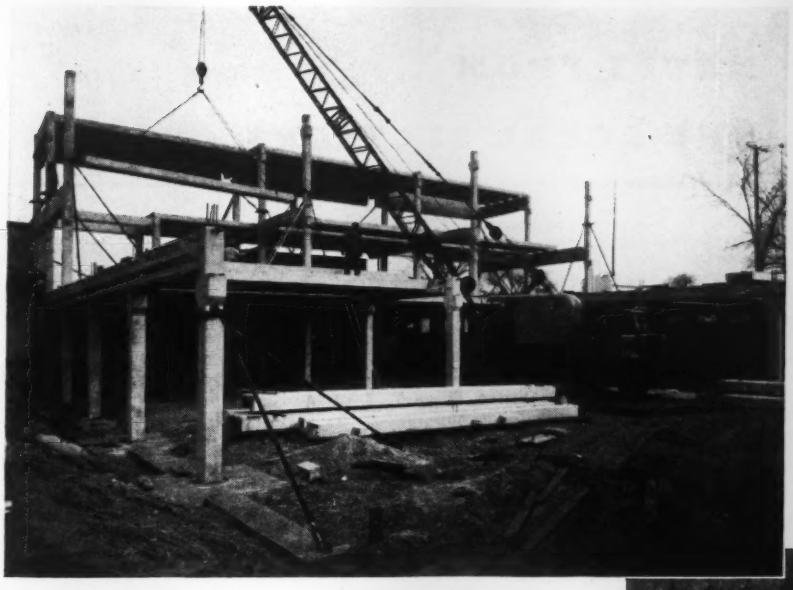
Serge Leliavsky received the Society's J. C. Stevens Award at a luncheon in London, on September 14, graciously arranged for him by the Institution of Civil Engineers of Great Britain as a gesture of good fellowship between the two societies. Dr. Leliavsky, who is a structural and hydraulic consultant in Maadi, Egypt, was unable to attend ASCE's Annual Convention in Pittsburgh, where the other Society prizes were presented. The luncheon group (shown here, left to right) consisted of Prof. A. J. S. Pippard; H. J. F. Gourley; W. K. Wallace, president of the Institution of Civil Engineers, who made the presentation; Dr. Leliavsky; David M. Watson; Sir Murdoch Macdonald, now 92 and oldest living past-president of the Institution; and Alexander McDonald, secretary of the Institution. In his acceptance Dr. Leliavsky mentioned his pleasure in seeing again Sir Murdoch Macdonald whom he had known in their work on Aswan Dam.

Spokane Section Host to Irrigation Conference

"The best yet" members of the Irrigation and Drainage Division voted their conference, held in Spokane, Wash., on September 7, with the Spokane Section as host. There were 83 engineers and their families registered, and attendance at each of the technical sessions ranged between 70 and 80. Field trips to Grand Coulee Dam and the Columbia Basin Project rounded out the program.

Charles S. Hazen was conference chairman, and C. A. Moore president of the Spokane Section. George N. Carter is chairman of the executive committee of the Irrigation and Drainage Division, and Herbert E. Prater is Division secretary.

Head table at joint dinner meeting of Division and Spokane Section, held at Davenport Hotel shows Harry F. Blaney, vice-chairman of the Division's executive committee; Louis D. Rydell, ASCE Director; George N. Carter, chairman of the executive committee; and Oliver T. Hartwell, ASCE Director.



The addition is approximately 91 ft. x 114 ft. with 16 ft. x 30 ft. bays. Prestressed beams run the 114 ft. length, spanning 16 ft. over the precast columns. Prestressed channel slabs of 12 in. depth span the 30 feet between the beams at floors and roof.

Owner: MINNESOTA RUBBER and GASKET CO., St. Louis Park, Minn.

Architect: MAGNEY, TUSLER & SETTER Minneapolis, Minn.

Precast concrete manufactured and erected by: PRE-STRESSED CONCRETE, INC., St. Paul, Minn.

PRESTRESSED AND PRECAST STRUCTURAL CONCRETE

FRAMING saved time and money for Minnesota Rubber and Gasket Company

The new three story addition to the St. Louis Park, Minnesota, plant of Minnesota Rubber and Gasket Company is constructed entirely of precast concrete columns and prestressed beams, floor channels, and roof channels. These modern materials cut framing costs 20%, permitted 4 months earlier occupancy and eliminated expensive fireproofing.

LEHIGH EARLY STRENGTH CEMENT

CEMENT saved time and money for Prestressed Concrete, Inc.

All structural units were cast in the modern plant of Prestressed Concrete, Inc. Using Lehigh Early Strength Cement and hot water curing, the concrete reached 3500 PSI in 12 hours. As a result, the manufacturer gained maximum production efficiency and economy through early removal of units and quick reuse of forms.

Whatever your cement requirements, there are Lehigh Cements to fit them. And remember, somewhere on nearly every job, Lehigh Early Strength Cement will save time and money.

Interior view of Prestressed Concrete's casting plant. Four channel beds at left are 200 ft. long. In center is bed for precasting reinforced beams. Next to the far right is a 100 ft. bed for prestressing beams. At far right is a form for precasting columns.

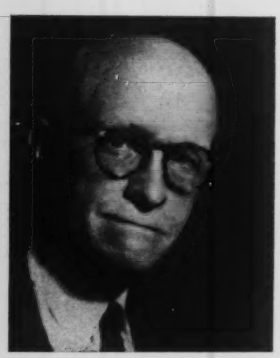
- LEHIGH EARLY STRENGTH CEMENT
- LEHIGH PORTLAND CEMENT
- LEHIGH MORTAR CEMENT
- LEHIGH AIR-ENTRAINING CEMENT

LEHIGH PORTLAND CEMENT COMPANY

Allentown, Pa.

Shortridge Hardesty, Hon. M. ASCE, Is Dead

Shortridge Hardesty, ASCE Honorary Member and internationally famous bridge designer, died at his home in Larchmont, N. Y., on October 17, at the age of 72. a partner in the New York consulting firm of Hardesty & Hanover, Mr. Hardesty had received wide recognition for his work on the Goethals and Outerbridge cantilever spans across the Arthur Kill for the Port of New York Authority;



Shortridge Hardesty

the Cooper River cantilever bridge at Charleston, S. C.; the Mississippi River cantilever bridge at Cairo, Ill.; the Hudson River lift bridges at Albany and Troy; the North and South Grand Island bridges and the Rainbow Arch Bridge over the Niagara River, and other spans throughout the country.

A graduate of Drake University in 1905, Mr. Hardesty received his civil engineering degree from Rensselaer Polytechnic Institute in 1908. He began his career with Waddell & Harrington in Kansas City, Mo., becoming designing engineer for the successor firm of Waddell & Son in 1916. Since 1920 he had been with the firm in New York—until 1926 as associate engineer with the late Dr. Waddell, from 1927 to 1938 in partnership under the firm name Waddell & Hardesty, from 1938 to 1945 in practice under the same name, and since 1945 under the firm name of Hardesty & Hanover with C. D. Hanover, Jr., as partner.

Long active in the Society, Mr. Hardesty was Director from 1946 to 1949, and had served as chairman of the executive committee of the Structural Division. He was also holder of the Norman Medal and the Thomas Fitch Rowland Prize for his papers in Transactions. Mr. Hardesty had also been chairman of the Column Research Council.

NOTES FROM THE LOCAL SECTIONS

(Copy for these columns must be received by the tenth of the month preceding date of publication.)

There was considerable business discussion at the **Akron Section's** September dinner meeting. W. R. Wagoner and Norman R. Cox were named Section delegates to the fall meeting of the District 9 Council. With baseball our traditional autumn preoccupation, Ernest Infield, sports writer for the "Wooster Daily Record," was featured speaker, and his talk was entitled "Ramblin' Round the Infield."

The **Alabama Section** is completing plans for its two-day meeting in Mobile on December 7 and 8. Members of the ASCE Executive Committee, headed by the new Society President, Mason G. Lockwood, are scheduled to attend and hold a meeting of their own. Mr. Lockwood will address the Section at a dinner on December 7. On the agenda, also, are several technical sessions, inspection of a modern concrete pipe plant, and a boat trip to the "Playground of Alabama" (Dauphin Island), which is under extensive development.

The **Alaska Section** was one of three sponsors of the Seventh Alaskan Science Conference, held at Juneau, September 27–30. Members of the **Anchorage Branch** who took part in the conference program attended a Branch meeting on October 1 and briefed the group on developments reported in the water supply, sanitation, and permafrost sessions. Speaker of the evening was John J. Teal, Jr., of the Institute of Northern Agricultural Research, Huntington Center, Vt., and owner of the only domesticated herd of musk ox in the world. The ox is valued for its wool, said to be twice as fine as the best cashmere and vicuna.

An informative talk on flood control plans for the Illinois River Basin—given by Louis D'Alba, chief of the Flood Control Division of the Chicago District of the Corps of Engineers—was featured at the **Central Illinois Section's** September meeting. Mr. D'Alba dealt, particularly, with the flood control program for the Sangamon River Valley, which is under immediate consideration, and with the relationship of Oakley Dam, a dual-purpose project, to the over-all program. The Section has accepted an invitation from the **Illinois Section** to be co-host to the ASCE Convention to be held in Chicago in February 1958.

Members of the **Cincinnati Section** are being urged to keep the first Wednesday of every month open for meetings. An enlarged Program Committee, under Vice-President Ray Raneri, has planned an outstanding series of meetings. For November 7 the subject is "Soft Ground Tunneling," and for December 5 it is "Building Codes" (with the AIA). On September 12 members and guests of the Section enjoyed a tour of the entire Armco steelmanufacturing process at Middletown, through the courtesy of Armco Drainage and Metal Products. Allison C. Neff, vice-president of Armco, discussed the civil engineer in his relation to the steel industry.

At the **Georgia Section's** October meeting J. Harold Bauer described the construction program for the Air Force Academy, with which he is familiar through an assignment as a member of Robert & Company, Associates. The Section now has an **Albany Branch,** consisting of about 25 members, which was formed at a recent dinner meeting in Albany. George S. Jenkins and R. S. Howard headed the organization committee. The current status of the nuclear power program was discussed at the September meeting of the **Central Savannah River Valley Branch** in Augusta by Joel V. Levy, assistant director of the Technical and Production Division of the Savannah River Operations Office of the AEC. C. D. Williams has been elected vice-president to complete the unexpired term of John Fowler, who has moved to Norfolk, Va. The **Savannah Branch** is sponsoring a meeting of the Savannah Joint Engineering Council on November 14. Maj. Gen. John R. Hardin, president of the Mississippi River Commission and division engineer of the Lower Mississippi Valley Division of the Corps of Engineers, will be the speaker. Reservations should be made through the Secretary of the Savannah Branch.

The **Intermountain Section** resumed its activities in September with a meeting devoted to the Utah registration law for engineers. Glenn Enke, chief designing engineer of the Columbia-Geneva Steel Division of the U. S. Steel Corp., gave an enlightening talk on the law, bringing the group up to date on changes effective January 1 in administration, registration fees, and the separation of professional engineer and land surveyor registration. Comments by Carl Painter and J. E. Christiansen, former members of the Registration Board, added to an understanding of the Utah law.

Reinforced concrete bridges start quicker . . . are completed sooner because all necessary materials and labor are readily available from local sources. These faster starts save months of delay. Furthermore, reinforced concrete is a flexible medium that permits an infinite variety of imaginative designs. Structures built with reinforced concrete are rugged . . . highly resistant to wind, shock, and quake. They are lower in first cost and require less maintenance. On your next bridge or overpass, design for beauty plus economy . . . design for reinforced concrete.

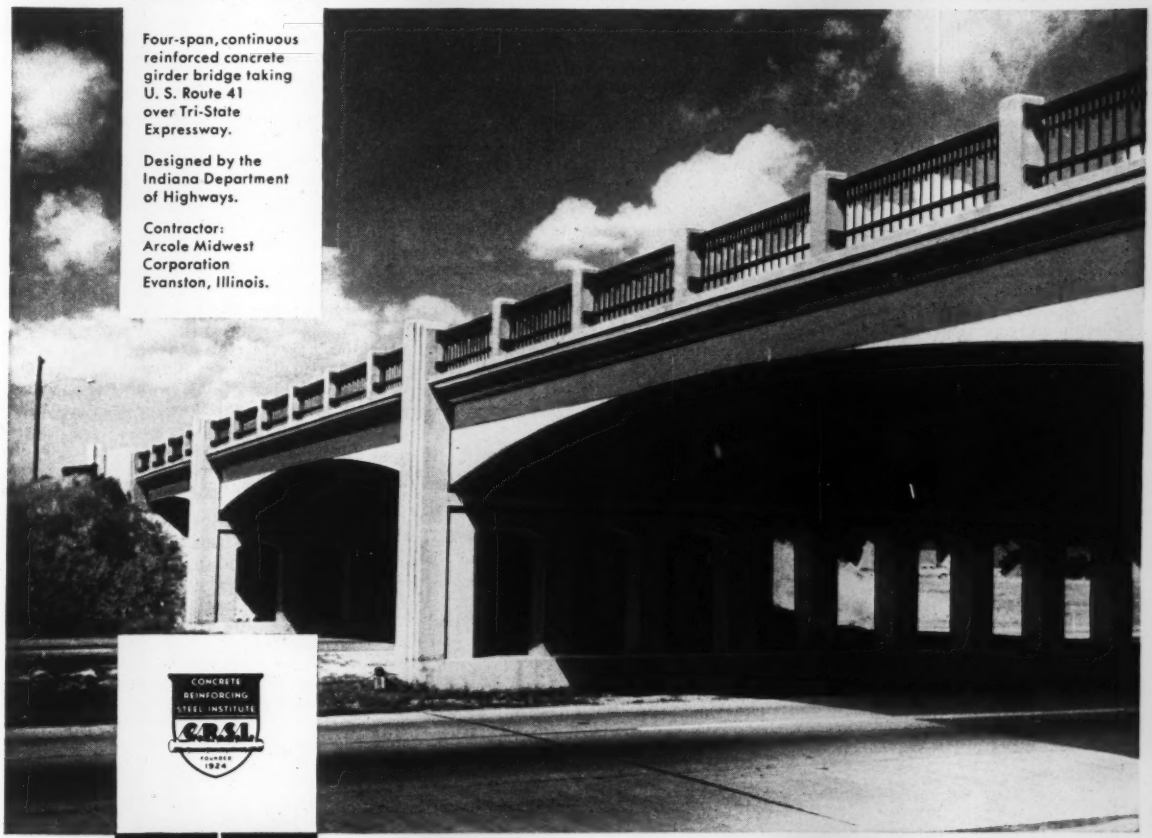
REINFORCED CONCRETE

bridges start quicker . . . are completed sooner

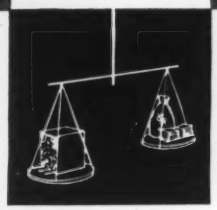
Four-span, continuous reinforced concrete girder bridge taking U. S. Route 41 over Tri-State Expressway.

Designed by the Indiana Department of Highways.

Contractor: Arcole Midwest Corporation Evanston, Illinois.



CONCRETE REINFORCING STEEL INSTITUTE CRSI FOUNDED 1924



Compare . . . YOU'LL SAVE WITH REINFORCED CONCRETE

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New **Ithaca Section** officers are A. F. Underhill, president; N. A. Christensen, first vice-president; W. W. Langhorst, second vice-president; and W. O. Lynch, secretary-treasurer. The Section reports that its annual prize of junior membership for a Cornell graduate went to Damon G. Douglas in the 1956 commencement season.

The facilities and accomplishments of the Midwest Research Institute were discussed at the **Kansas City Section's** September meeting by Fred Stephens, manager of the Engineering Division. Starting in 1944 with a staff of three, the Institute in its eleven years of full operation has handled some 2,000 research projects for 717 companies, and now represents a $1,000,000 operation.

Good news from the **Kansas Section**—225 members have paid their Section dues. This is 38 more than in the best previous year when the Section roll included ASCE members in Johnson and Wyandotte counties, too. R. T. Fry, engineer for the Highway Planning Department of the Kansas Highway Commission, was featured speaker at the Section's September meeting, with a talk on the value of origin-destination surveys, especially in planning for turnpikes and superhighways.

Executive Secretary William H. Wisely was guest speaker at the **Kentucky Section's** opening meeting of the season on September 12. His talk dealt with the operation of Society Headquarters, its services and its goals, and was followed by a question-and-answer period. Recipients of the Kentucky Section Scholarship Awards—Aubrey D. May, of the University of Kentucky, and William D. Shrader, of the University of Louisville—were introduced to the members and spoke briefly.

The first issue of the **Maine Section's** new publication, "The Yankee Engineer," which will be out this fall, has lined up some good articles dealing with the new highway program. It will also include information on the Section's Seventh Annual Highway Conference, scheduled for December 14 and 15 at the University of Maine.

The jurists's view of New York City's traffic problem was presented to **Metropolitan Section** members at the opening meeting of the season on September 19 by John M. Murtagh, chief city magistrate. The talk emphasized the civil engineer's stake in the traffic and transportation problem.

In the interest of greater democracy, the **Nashville Section** has adopted a new system of electing its officers. Each member is being mailed a postcard, with appropriate spaces for the nomination of one candidate for each Section office and for the two Section directors. The two members receiving the highest number of nominating votes will be put up as the candidates for each office in question.

Recent developments in steel construction were detailed at the October meeting of the **National Capital Section** by Eugene P. Cassin, of the Philadelphia regional office of the American Institute of Steel Construction. Mr. Cassin covered four phases of development: (1) the field of design, with emphasis on plastic analysis as a useful tool for the designing engineer; (2) the field of connectors in structural steel, with a citation of the advantages of high-strength bolts; (3) corrosion-resistant paints for structural steel; and (4) the problem of supply of structural shapes (there is some shortage now, but the steel industry is confident there will be enough structural steel to meet the requirements of the road program when the construction peak is reached). The **Junior Forum** cooperated with the Section in putting on the program.

For the first meeting of the new season, on September 19, the **Nebraska Section** featured a talk on the proposed improvement of the Omaha sewerage system by C. W. Durham, president of Henningson, Durham & Richardson, Omaha. Recent studies indicate the urgent need for immediate improvement and a long-range development program, Mr. Durham pointed out. A new Committee on Membership, under the chairmanship of Edward Soucek, has been formed.

Principal speaker at the **Northwestern Section's** October meeting was Charles F. Intlekofer, construction engineer for the Great Northern Railway, who discussed the line's new $6,500,000 railroad yard at Minot, N. Dak. Colored slides showed all stages of construction and explained the automatic operation of the yard.

Discussion of the 1,500-mile transmission line, which will bring natural gas from the San Juan Basin in New Mexico to the Pacific Northwest, got the **Oregon Section's** first meeting of the new season off to a good start on September 20. The speakers were Paul Howe and R. T. Miller, engineers for the Portland Gas and Coke Co. Don Johnston showed a film illustrating the construction highlights. Oddly enough, the final location of the line paralleled, in many instances, the route of the old Oregon Trail.

After 28 years of publication, the **Philadelphia Section** is abandoning its distinguished monthly newsletter, "The News." Replacing it and the other publications of organizations affiliated with the Engineers Club of Philadelphia is the Club's official new publication, "The Delaware Valley Announcer." Mailed free each month to the 25,000 engineers in the Delaware Valley, the new publication will keep the engineers of the area abreast of the tremendous industrial development and myriad activities of the valley as they affect the profession. It will also give space to announcements and activities of each of the affiliating societies—the Philadelphia Section among them, of course. A cordial *ave* to "The Delaware Valley Announcer," and a sad *vale* to "The News."

The **Sacramento Section's** Speakers' Club is beginning another year. One of the Section's ambitions this year will be to

Massachusetts Section concluded its third successful season of summer luncheon meetings at Boston City Club on September 19. James E. Haley (center), soils consultant, addressed an audience of 125 on "Design and Construction Difficulties in Peat Areas." Shown here, left to right, are John J. Walsh, chairman of Summer Program Committee; Prof. Ernest L. Spencer, secretary-treasurer; Mr. Haley; Edward C. Keane, president; and A. Russell Barnes, Jr., vice-president.

No "Cure-All," but...

Salinas, California, finds a single grade of Bitumuls® solves five paving maintenance problems

HERE'S A SITUATION common to most growing cities: annexation of outlying residential developments has vastly expanded the street maintenance job *without* materially increasing available funds. Annexation has not only added to the street mileage, but has "contributed" many sub-standard pavements to the street system, thus adding to the complexity of the job.

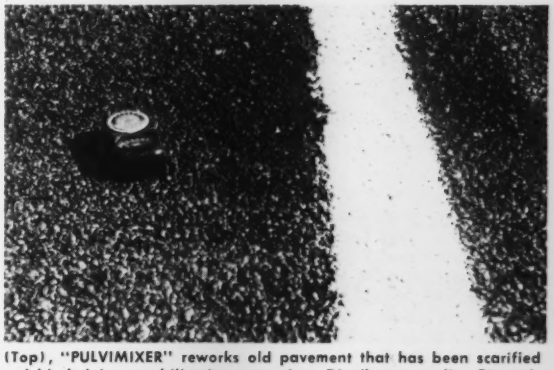
In an effort to solve this problem, these three Salinas men most directly concerned have worked together: Thomas A. Dunne, Director of Public Service; his assistant, Al Rossi; and Harry Adams, Maintenance Supt. Their search for simplicity and standardization led them to look for a versatile asphalt material that would do many jobs. They found it in Bitumuls SS-1, an asphalt emulsion that can be handled and used without heating, in small quantities or large.

Now, stored in a single 25,000-gallon tank, Bitumuls SS-1 is used for: Patching, Tack Coats, Prime, Seal Coats & Surface Treatments, and for Base Stabilization. In addition, Salinas City Forces can also use this same grade of Bitumuls for the new Slurry Sealing; and—at high dilution—for dust-laying on unpaved, outlying roads. All of these jobs can be done with existing equipment: a grader, a "Pulvimixer", a water wagon, two distributors, and a roller.

The obvious economies resulting from the use of this one material for all these jobs merit investigation by paving maintenance men everywhere, regardless of the size of their community.

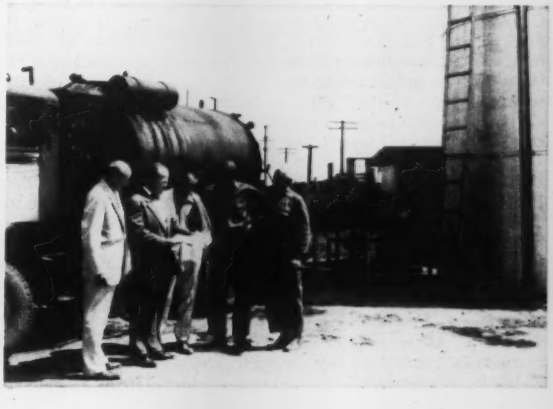
There's a Bitumuls man near you who can supply details. *Call him, today, or write:* **American Bitumuls & Asphalt Co., 200 Bush St., San Francisco 20, Calif.**

See you at the Road Show, Chicago, Jan 28–Feb 2, Booths 23, 24, Materials & Supplies Section.



(Top), "PULVIMIXER" reworks old pavement that has been scarified and bladed in restabilization operation. Distributor applies Bitumuls at ¾ gal./sq. yd. per inch of depth. (Center), DISTRIBUTOR applies prime on a waterbound base, using Bitumuls SS-1 diluted (2 parts SS-1 to 1 part water) at 0.3 gal./sq. yd. of dilution. (Bottom), HERE'S A CLOSE-UP of the finished texture of a Bitumuls SS-1 Seal Coat pavement.

(Right), SALES ENGINEER Bob Ridell, far left, of American Bitumuls & Asphalt Co., discusses plans with Tom Dunne, Director of Public Service for Salinas, and his assistants. At far right is a partial view of the 25,000 gal. storage tank. (Below), EVEN SCHOOL YARDS are given stabilized bases with Bitumuls SS-1.



Top Society and Section officers get together at Austin, Tex., during Texas Section's fall meeting on October 4 and 5. In usual order, they are Mason Lockwood, President-elect of ASCE; Raymond Dawson, Director of District 15; Randle Alexander, Director-elect of District 15; ASCE President Enoch R. Needles; and W. H. Wisely, Executive Secretary of ASCE. The first three dignitaries are all Texas Section members. The fall meeting attendance of almost 400 included 77 students and 97 ladies.

reduce the average age of speakers from around 45 to something less. Many of the club's charter members still belong and, as is to be expected, are excellent speakers. The Section believes, however, that there are many younger members who would do well to develop their latent talent. As "The Engineerogram" puts it, "It is hoped that all who have any ambitions of any sort in regards to public speaking will reserve the first Thursday of each month from October through June for the Speakers Club."

Active preparations for the Third World Congress on Irrigation and Drainage, to be held in San Francisco next spring, have been started by members of the **San Francisco Section,** participating with other interested groups on the California Steering Committee. The congress is sponsored by the International Committee on Irrigation and Drainage, and the host will be the U. S. National Committee, of which W. E. Blomgren, of Denver, is chairman. The dates are April 29 through May 4. The Section has fourteen new life members: Frank E. Bonner, Thomas H. Campbell, Robert M. Copeland, Shirley T. Corfield, Walter Dreyer, Robert R. Fisher, John R. Fox, Harry P. Hart, Herbert J. King, Samuel P. Laverty, Charles Millichamp, Stephen H. Searancke, Oswald Speir, and Ralph G. Wadsworth.

Texas Section Branches are electing new officers. Reporting to date are the **Brazos County Branch,** with Codie D. Wells, president, Truman R. Jones, Jr., vice-president, and Prof. Edmund P. Segner, Jr., secretary-treasurer; the **Dallas Branch,** with James R. Padgitt, president, W. L. Powell, vice-president, and Harvey E. Bradshaw, secretary-treasurer; the **El Paso Branch,** with F. Ralph Shouse, president, Guy P. Ridout, vice-president, and Harold E. M. White, secretary-treasurer; the **Fort Worth Branch,** with W. R. Hardy, president, Don L. Wood, vice-president, and James R. Nichols, secretary-treasurer; the **Houston Branch,** with William O. Swift, president, Bramlette McClelland, vice-president, and Norman Hueni, secretary-treasurer; and the **Southeast Branch,** with Joseph A. Sale, president; Luther A. Beale, vice-president; and Ben H. Anderson, secretary-treasurer. A Western Hospitality Outing at the Preston M. Geren Spring Creek Ranch opened the fall season for the Wives of the **Fort Worth Branch.** About 60 members and their husbands made the trip by chartered bus, partook of the ranch supper, and enjoyed skits and tricks put on by Master Magician Albert E. Levulis. All arrangements were handled by a committee of hostesses headed by Mrs. D. W. Robinson. Mrs. W. R. Hardy is president of the group for the forthcoming year.

Guest speaker at the **Toledo Section's** first meeting of the 1956–1957 season was Linton Hart, district manager of the Raymond Concrete Pile Co., who spoke on the construction of the Texas Tower recently set up in the Atlantic. Mr. Hart also showed an interesting film on the project, said to be "one of the finest construction films ever taken."

Coming Events

Alabama—Joint meeting with the Student Chapters at the University of Alabama and Alabama Polytechnic Institute at the Battle House Hotel, Mobile, December 7 and 8. Col. Harold E. Bisbort, Mobile, Ala., is in charge of arrangements.

Kansas City—Sanitary Engineering Conference at the Continental Hotel, Kansas City, Mo., November 19 and 20. Information may be obtained from Glenn C. Gray, Chairman, Subcommittee on Publicity, Larkin and Associates, Consulting Engineers, 19 East Gregory Blvd., Kansas City, Mo.

Maine—Seventh Annual Highway Conference, sponsored by the Section, Maine State Highway Commission, and University of Maine Student Chapter, at University of Maine, December 14 and 15. Third Annual Highway Conference, sponsored by the New Hampshire Branch, at the University of New Hampshire, December 7, beginning at 9 a.m.

Massachusetts—Dinner meeting at M.I.T. Graduate House on November 19 at 7 p.m., preceded by laboratory visit at 4:30 p.m. and social hour at 6 p.m. Reservations must be made through Prof. Ernest L. Spencer, secretary-treasurer, Northeastern University, Boston 15, Mass., by November 16.

Metropolitan—Regular meeting in the Engineering Societies Building, November 14, at 7 p.m. Meeting of the Junior Branch, Engineering Societies Building December 5, at 7 p.m., with Frank L. Whitney, vice-president of engineering for Walter Kidde Constructors, Inc., speaking on "The Professional Engineer and the Corporation Viewpoint."

Scheduled ASCE Conventions

JACKSON CONVENTION
Jackson, Miss.
Hotel Heidelberg
February 18–22, 1957

BUFFALO CONVENTION
Buffalo, N. Y.
Hotel Statler
June 3–7, 1957

ANNUAL CONVENTION
New York, N. Y.
Hotel Statler
October 14–18

When a welded frame building has more useable space...

Has far simpler connections...

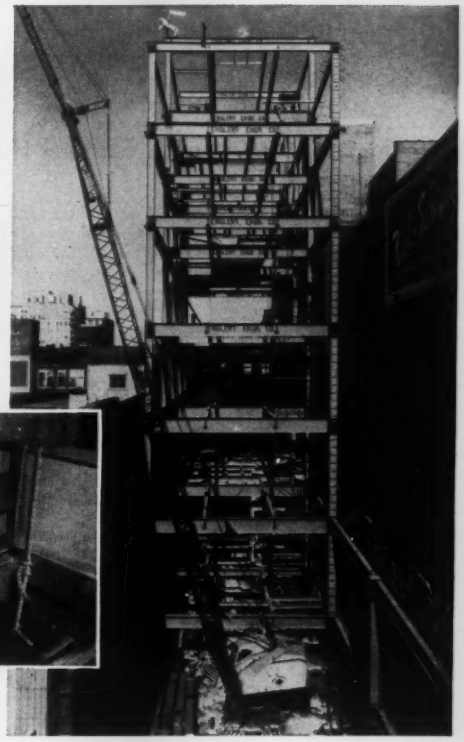
Yet uses less steel...

WHY

don't you design all buildings for welded construction

All-welded 7-story framework—*Width of structure is only 300 feet with cross beams connected to columns in rigid frame design.*

Welding cross beam web-to-column flange *with Lincoln Fleetweld 5 using Lincoln welders. Jetweld 2 iron powder electrodes are used for downhand work.*



SAVES $10 A TON WITH WELDED DESIGN

A REDUCTION in cost of $10 per ton has been realized through the use of all-welded, rigid frame design on the 7-story Harvey's Department Store in Nashville, Tennessee. The estimated saving results from faster, simpler shop fabrication and detailing over bolted or riveted design.

The welded design used here achieves rigid framing for wind resistance and permits matching of floors in adjacent building without bulky connections normally required with bolting or riveting.

Architects: Marr & Holman, Nashville; Fabricators and Erectors, Englert Engineering Company, Nashville; General Contractor, Sumner Construction Company.

For Studies in Structural Arc Welding write

THE LINCOLN ELECTRIC COMPANY

DEPT. 2410 • CLEVELAND 17, OHIO

Pioneer in Welded Structural Design . . . for Lower Cost

NEWS BRIEFS . . .

Bertram Tallamy Named Federal Highway Administrator

President Eisenhower has nominated Bertram D. Tallamy, M. ASCE, chairman and executive officer of the New York State Thruway Authority, to the important new post of Federal Highway Administrator. After confirmation by the Senate, Mr. Tallamy will take office in January. The interim administrator is John A. Volpe, who has just resigned as Massachusetts Commissioner of Public Works to return to private business.

The key sub-cabinet administrative job, which was created in the Federal Aid Highway Act of 1956, carries with it new authority and responsibility in the highway field. The new administrator will have direct responsibility for the administration of the Bureau of Public Roads and the National Highway Program.

Commenting on Mr. Tallamy's appointment, Secretary of Commerce Sinclair Weeks stated: "The President, in selecting Mr. Tallamy, has chosen one of the world's greatest builders of roads to fill the new position of Federal Highway Administrator. This assures the nation that history's biggest public works project, involving billions of dollars, will be constructed with outstanding skill, speed, vision, and integrity." Before making the appointment he said, the President sought advice "from authorities in highway, transportation, public works, and related fields."

Mr. Tallamy is prominent in the construction field and has long been identified with New York State's public works program, especially construction and operation of the famous 562-mile Thruway. As deputy chief engineer and chief engineer of the Niagara Frontier Planning Board, he was responsible for planning initial sections of both the Thruway and New York State's Arterial Route System. As state deputy superintendent of public works, he coordinated the state's multi-million-dollar postwar construction program, and handled its first analysis of highway conditions and future needs. He served as superintendent of public works from October 1, 1948, until December 31, 1954. His current commitment as chairman of the New York State Thruway Authority prevents his taking over the post of Federal Highway Administrator until January. Mr. Tallamy has been active in the

ASCE Highway Division, and is now vice-chairman of its executive committee.

After the highway bill had been enacted into law, the Society on July 30 sent a telegram to President Eisenhower urging that "in view of the tremendous importance of the new engineering program to the economy, national defense, and safety of traffic," the newly authorized post of Highway Administrator be filled by a "fully qualified administrator." Copies of the telegram, which was signed by President Needles, were sent Secretary Weeks and others closely connected with working out the program.

New York International Airport to Have New Arrival Building

Eleven city blocks long is this new Arrival Building, under construction by the Port of New York Authority at New York International Airport. Shown here in photo of a scale model, the building will be the largest structure in the 655-acre $60,000,000 "Terminal City" development. The $27,000,000 steel and concrete building will handle all incoming passengers requiring Customs clearance. This structure and two adjacent Airline Wing Buildings are scheduled for completion sometime next year. Later a 320-room hotel will be added to the facilities of the Terminal City development.

New York's First Stainless Steel Skyscraper Dedicated

Formal dedication and official opening of the 45-story Socony Mobil Building took place on October 17. Occupying the whole block between Lexington and Third Avenues and 42nd and 41st Streets, the building is the largest stainless steel skyscraper in the world and the first to be built in New York City. Benjamin F. Fairless, M. ASCE, president of the American Iron and Steel Institute and retired chairman of the board of U. S. Steel, headed the group of notables taking part in the dedication ceremonies.

Placing of the world's first "cornersteel," instead of the traditional cornerstone, was a feature of the ceremonies. The two-part "cornersteel," consisting of a dedicatory outer plaque concealing a time capsule, was made of stainless steel. Messages from President Eisenhower, Governor Harriman, and Mayor Wagner were placed in the capsule, along with a copy of each New York newspaper of the date and predictions by the major corporations tenanting the building on the status of their industries in the year 2056.

The capsule also contains documents detailing the construction of the unusual structure, the largest metal-clad building in the world. More than 750,000 lb of stainless steel was required for the exterior sheathing and for the 3,200 windows, which pivot to permit cleaning from inside the building. The weight saving permitted by the use of the sheathing—approximately 2 psf, as compared with 48 psf for a 4-in.-thick brick exterior wall—was a factor in its selection. To meet the requirements of New York's building and fire codes, a masonry wall 4 in. thick backs up the stainless steel skin with air space between. Ground was broken for the building on March 30, 1954.

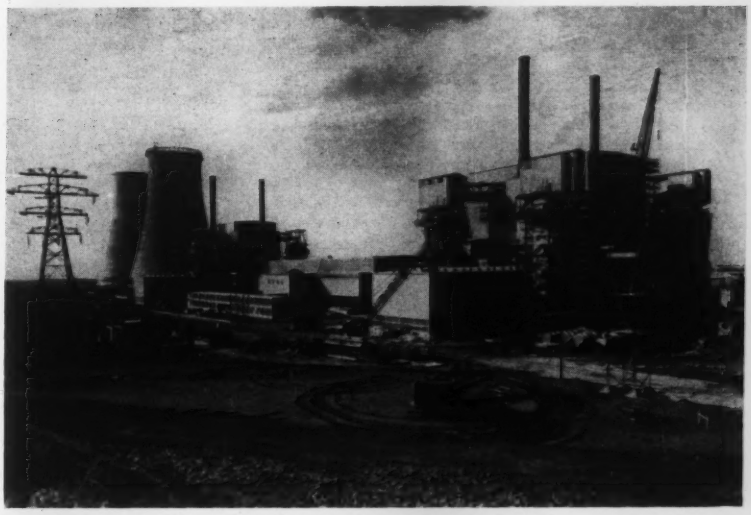
Edwards & Hjorth were the structural engineers; Jaros, Baum & Bolles, the mechanical engineers; and Harrison & Abramovitz and John B. Peterkin, the associated architects. The general contractor was the Turner Construction Co.

Proceedings of Arid Lands Conference

Important to all concerned with the ubiquitous problem of arid lands are the two recent Arid Lands Conferences, held at Albuquerque and Socorro, N. Mex., and attended by representatives from 28 countries. Symposium papers and 31 conference recommendations for new lines of research have been reproduced by the American Association for the Advancement of Science in a 464-page illustrated volume, entitled *The Future of Arid Lands*. Gilbert F. White, of the University of Chicago Geography Department, is the editor.

The stimulating volume sells for $6.75 prepaid, and may be obtained from the AAAS, 1515 Massachusetts Avenue, N.W., Washington 5, D. C. For AAAS members there is a special price of $5.75.

England Dedicates First Atomic Power Station



Calder Hall Atomic Energy Power Station at Cumberland, England—the first in history to pump electricity in marketable quantities to a national grid system—was officially opened by Queen Elizabeth on October 17. The huge project, which has been under construction since August 1953, is one of two units. A similar unit (identified as Calder Hall "B" Station) was begun in 1955 and is scheduled for completion by the middle of 1958. The present installation includes two 120-ft-high reinforced concrete buildings to house the nuclear reactors. Each of the buildings (shown here in the left foreground) is founded on a heavily reinforced concrete raft, 130 ft by 107 ft across and 11 ft deep. As further protection, the concrete shielding is lined with slabs of 6-in. steel armor plate—each slab weighed three tons, and 500 of them were required for each reactor. The administration block is at the right. The contractor for the United Kingdom Atomic Energy Authority was Taylor Woodrow, of London.

Cooper Union Convocation Studies Shortage of Engineers

All phases of the threatened shortage of technological manpower in the United States were explored at a two-day convocation sponsored by Cooper Union, in New York, on October 8 and 9. The convocation featured a series of discussions by national figures in education, industry, and government, who gathered to study the recruitment, preparation, and utilization of engineers and scientists. It was held under the auspices of a newly organized Cooper Union Centennial Committee, headed by former President Herbert Hoover, Hon. M. ASCE. The committee was formed to lend support to a program, which looks forward to the celebration, in 1959, of the tuition-free college's one hundredth anniversary.

Four college presidents were the panelists in a discussion devoted to the theme, "Engineering Education and the Future of America." They were Dr. T. Keith Glennan, of Case Institute of Technology; Dr. William V. Houston, of Rice Institute; Dr. J. T. Rettaliata, of Illinois Institute of Technology; and Dr. J. C. Warner, of Carnegie Institute of Technology. Other distinguished speakers included Dr. Howard L. Bevin, chairman of the National Committee for the Development of Scientists and Engineers, and Associate Justice Felix Frankfurter, of the United States Supreme Court, who addressed an Alumni Day Luncheon preceding the convocation.

Lewis L. Strauss, chairman of the United States Atomic Energy Commission, was principal speaker at a banquet in the Waldorf-Astoria that climaxed the two-day program. In his talk, which was entitled "The Place of Technical Education in America's Future," Admiral Strauss commented that, "We are now paying the price for an unfortunate miscalculation of the late forties when our young people were advised *not* to choose careers in engineering because the field was becoming overcrowded. . . . We are paying a heavy penalty now for such errors. Engineering

was de-emphasized at a time when we should have been building a reservoir of skilled manpower from the large G.I. enrollments after the war."

Admiral Strauss also deplored the "steady decline in science and mathematics teaching in our high schools. It is in the high schools," he emphasized, "that young people reach the age when ordinarily they are fired with ambition to prepare for a career. Colleges and universities cannot graduate technically trained people if students do not come to them with an objective and with adequate scholastic preparation. . . . It is not simply a matter of our teen-agers losing interest in the subjects. There is the further disheartening statistic that about one-fourth of all the high schools in the United States offer their students neither physics nor chemistry.

"It should be a matter of national chagrin," Admiral Strauss continued, "that of our most intelligent high school students—those in the upper 20 percent of their classes—fewer than half go on to college. And of those who *do* continue on, only about one-third remain and graduate. The others drop out somewhere along the line for various reasons. College deans of engineering tell us that perhaps first among the reasons is poor high school preparation," Admiral Strauss concluded.

Former President Hoover paid tribute to the vision of Peter Cooper, which "spread into all our American universities. They began," he said, "the creation of a great profession far in advance of all other nations. Oxford and Cambridge did not adopt engineering as a worthy profession until after the first World War. That was fifty-eight years after Peter Cooper. And in the meantime, thousands of American engineers from the Cooper Union and our universities were in demand by every progressive foreign nation. At one time I could enumerate over two thousand of them abroad in forty countries."

Chicago Road Show Focuses Attention on New Equipment

"Productivity on Parade" is the theme of the 1957 Chicago Road Show, which the American Road Builders Association will stage in the capacious International Amphitheatre, January 28–February 2. With interest in road building at an all-time high, the Road Show is expected to attract a large attendance of contractors, city, county and state officials, and others concerned with the new National Highway Program. The exhibit—the first ARBA Road Show since 1948—will feature the impressive developments of the past nine years in the field of road machinery and give a glimpse into the future via 250 manufacturers' exhibits of new equipment.

The ARBA emphasizes the fact that the mechanization of the road-building industry, more than any other one factor, is responsible for our vast network of modern highways. "Fifty years ago," according to a leading equipment manufacturer, "manual methods accounted for 95 percent of the work on highway jobs, and power equipment handled only 5 percent. Today almost the opposite is true." In calling attention to the relative economy of this modern equipment over men-and-mule methods, the ARBA reports a study of comparative costs made by experts in the Bureau of Public Roads. The study shows that if today's contractors were to use the same machinery and methods employed in 1923, current highways costs of $1.00 would top $1.90.

In making the point that today's tough projects would probably be impossible without the big excavation and earthmoving machines now available to the contractor, the ARBA cites two current projects—the Massachusetts Turnpike and the Kansas Turnpike.

To build the 123-mile superhighway across the Bay State, it says, "road builders have had to gouge their way through rock-solid hills, shifting in the process nearly 40 million cubic yards of earth. To pave the turnpike, they have had to place a million tons of bituminous concrete, 1.7 million tons of crushed stone, 6 million cubic yards of gravel, 600,000 cubic yards of concrete, and 60,000 tons of steel. Contractors threw a gigantic fleet of powerful machines into this job and are finishing within a few short months a project which, without modern equipment, would have taken a decade to complete."

In reference to the Kansas Turnpike, which is being completed this fall, the ARBA exclaims, "Who would have imagined, 20 years ago, that a 236-mile-long highway, four lanes wide, could be paved in one construction season! Yet, except for a short seven-mile section poured last fall, that is what has been accomplished on the Kansas Turnpike. Sixteen paving contractors 'ganged up' on the job to complete it within a six-month period." The secret of their accomplishment, according to observers, was emphasis on assembly line methods.

One industrial leader recently observed, "The contractors who make the most of the National Highway Program will be those who have learned how to manipulate equipment—how to pick the right machine for the job at hand, how to set up the most productive combinations." The ARBA Road Show is perfectly timed to give precisely this type of information and help.

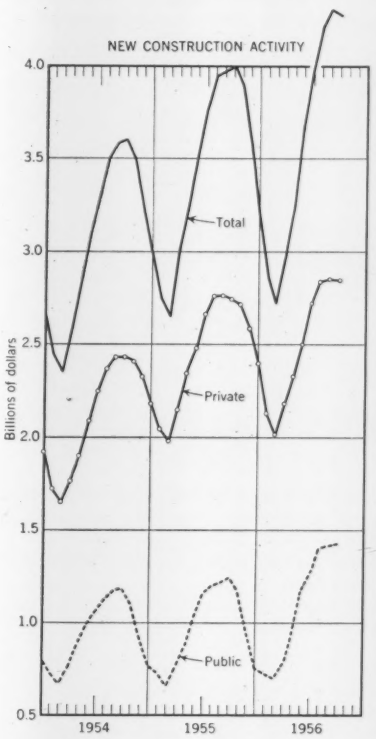
Recently completed 236-mile Kansas Turnpike is a good example of how quickly modern equipment can produce pavement. Left-hand photo shows three asphaltic concrete pavers, operating in tandem and laying down almost a mile a day of 2½-in. topping of mixed aggregate and hot asphalt. View at right shows portland cement concrete section of the turnpike, where another contractor used two huge mixers, outside the forms, to pour half a mile of road a day—a 4-in. base, 1-in. sand course, and 10-in., 24-ft slab.

September Construction Activity Continues Record Pace

New construction activity for September exceeded $4.2 billion for the third consecutive month and rounded out the most active construction quarter on record, according to preliminary estimates of the U. S. Departments of Commerce and Labor. The value of new work put in place during the month brought the third-quarter total to nearly $12.8 billion, 3 percent more than in the July-September 1955 period. After adjustment for seasonal factors, new construction activity in the third quarter of 1956 was at annual rate of $44.5 billion, compared with actual outlays of $43 billion in 1955. During the first nine months of the year a record $32.7 billion was put in place.

Private industrial building continued at a record rate in September, exceeding for the first time the $800 million mark. Construction of office buildings and churches was also at a new high for the month. Private residential building held steady at about $1.4 billion a month during the third quarter, but the $4.3 billion total for the quarter was 10 percent below the record set in the July-September period last year.

Public construction reached a new high in September, establishing another monthly record for highway construction. Public school building and work on water and sewer facilities were at near peak levels for the third consecutive month. The value of work installed for these three important types of public works, undertaken primarily by state and local governments, accounted for two-thirds of the total public construction expenditures in the quarter just ended. Outlays for military facilities in the United States reached a postwar monthly high of $148 million.



September construction expenditures, in excess of $4.2 billion, bring the construction total for the first nine months of the year to a record $32.7 billion.

Hell's Canyon Ruling Is Upheld by Federal Court

A ruling upholding the right of a private utility company to build three hydroelectric dams in Hell's Canyon has been made by a three-judge panel of the Federal Court of Appeals. The canyon lies along the Snake River, a tributary of the Columbia, on the border between Idaho and Oregon.

On October 8 the panel ruled that the Federal Power Commission did not violate the Federal Power Act of August 4, 1955, when it granted the Idaho Power Company a fifty-year license to build and operate low dams at three developments, known as Brownlee, Oxbow, and Low Hell's Canyon. The opinion, which was written by Judge Wilbur K. Miller, stated "We find no instance in which the commission went beyond the confines of the Constitution or the governing statute."

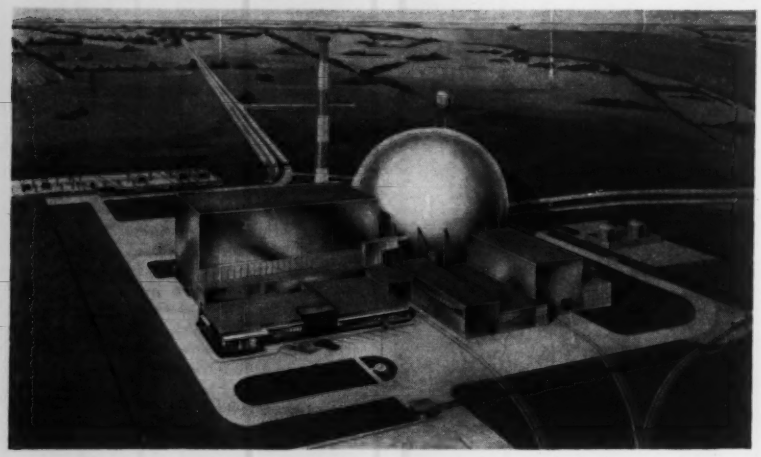
For some years there has been a controversy as to whether the Federal Government or private interests should develop the power resources of the Hell's Canyon area. Public power proponents, headed by the National Hell's Canyon Association and the National Rural Electric Cooperative Association, have been urging construction of a single high dam to generate power as part of the Federal Government's comprehensive plan for development of the Columbia River Basin.

Cost of the Idaho Power Company's project, which is already under construction, is expected to be about $175,000,000. The proposed high dam project, according to the Federal Court of Appeals, "would probably run to something more than twice that sum."

Coal to Be Delivered by Pipeline in Ohio

Coal will shortly be flowing across Ohio through this 108-mile pipeline, which is being built between the Hanna Coal Company's strip mines, south of Cadiz, Ohio, and the Cleveland Electric Illuminating Company's Eastlake Generating Plant, just east of Cleveland. The coal, pulverized and suspended in water, will be pumped through the 10-in. pipeline at the rate of about 3½ mph, then dried and fed into the station's steam-generating boilers. Anticipated capacity of the line—the first of its kind in the United States—is 1,300,000 tons of coal a year. Ford, Bacon & Davis, Inc., is responsible for the engineering design and supervision of construction of the pipeline and pumping stations. Williams Brothers Co. is the pipe-laying contractor, and the Poling & Bacon Construction Co. the station contractor. Photo courtesy of the Lincoln Electric Co., Cleveland.

Midwest Utilities Plan $45,000,000 Nuclear Power Station



Artist's sketch shows layout of Dresden Nuclear Power Station, which General Electric will build for the Commonwealth Edison Co. and the Nuclear Power Group, Inc. The nuclear reactor will be housed in a 190-ft-dia steel sphere. Construction work on the $45,000,000 plant will start next spring, with completion set for mid-1960. The 180,000-kw station, which is being financed entirely with private funds, is the largest all-nuclear power plant scheduled to date in this country. It will be located on the Illinois waterway 50 miles southwest of Chicago, and become part of the Commonwealth system which will own and operate the plant.

Contractors Foresee Further Construction Increase

With construction at the highest level in history, the results of a telegraphic survey conducted by the Associated General Contractors of America among its directors and the officials of 124 AGC chapters in all parts of the country show that a majority expect continued increases in all major categories of the industry in the next six months. The contractors expect, also, that new construction will reach a record-breaking $44.5 billion, a 4 percent gain over last year, and that additional expenditures for maintenance and repair will bring the grand total to $60 billion.

Not unnaturally, more of the respondents anticipated an increase in highway construction than in any other category. Gains in work on new buildings and in heavy engineering and railroad construction were also forecast in a majority of the replies.

The survey indicates that, despite the large volume of work, competition among general contractors for work coming on the market will remain keen and, possibly, become even more intense. Contractors' bid prices will tend to rise because of the pressure of higher material prices and wage rates.

In reporting the results of the survey to 400 construction leaders, who met in Milwaukee in September to discuss the mid-year report of the governing board of AGC, J. D. Marshall, executive director of the AGC, told the group that the shortage of construction materials is expected to continue temporarily. "There are reasons to believe," he said, "that even greater expansion programs than those now underway will have to be undertaken by the steel, cement, and other industries supplying construction."

Work Starts on Glen Canyon Dam Project

From the White House, on October 15, President Eisenhower by telegraph key set off a blast that signaled the start of construction, in a remote area of the West, of Glen Canyon Dam, a key unit in the Colorado River Storage Project. The new dam, which is located on the Colorado River in northeastern Arizona, some 370 miles upstream from Hoover Dam and 13 miles downstream from the Utah-Arizona state line, is the only one of the authorized dams of the Colorado River Storage Project to be built on the river proper.

A Bureau of Reclamation project, the new dam will be a concrete-arch structure 700 ft high, which will make it the fourth highest dam in the world and only 27 ft lower than Hoover Dam, highest in the United States. It will have a crest length of 1,400 ft, a radius of 1,000 ft, and maximum thickness at the base of 425 ft. The reservoir created by the dam will extend 186 miles up the Colorado River and 71 miles upstream on the San Juan, and will impound 26,000,000 acre-ft of water, only about 5,000,000 acre-ft less than the capacity of Lake Mead.

The powerplant will have an installed capacity of 800,000 kw. When the plant is in operation, it will rank as the Bureau of Reclamation's third largest, being surpassed in size only by the Grand Coulee and Hoover Dam plants.

Initial work on the Glen Canyon project will consist of the construction of a diversion tunnel in the west wall of the canyon, for which the Mountain States Construction Co., of Denver, has been awarded a $2,452,340 contract. During construction the river will be sidetracked through the tunnel and another like it in the opposite canyon wall. Both will be 45-ft-dia horseshoe-shaped tunnels, with their lower ends concrete lined. After the dam is completed and storing water, the concrete-lined portions will be used for overflow discharge from the spillways.

The cost of Glen Canyon Dam will be some $421,000,000—more than half the project total of $760,000,000. It will be repaid to the Federal Treasury through the sale of electrical energy from the Glen Canyon Powerplant.

August Housing Starts Remain at July Level

Nonfarm housing starts in August held steady at the July level of 101,000 units, according to the U. S. Labor Department's Bureau of Labor Statistics. Building-permit authorizations actually rose slightly during the month for construction of units to be started in August or in later months. Geographically the increase in building permits was widespread.

Private housing starts of 100,500 units, which accounted for almost the entire August 1956 total, showed a slight increase over the 99,100 private units in July. The August total represented a seasonally adjusted annual rate of 1,110,000 units, compared with 1,070,000 for the preceding two months.

A total of 783,000 units, including both private and public, were begun during the first eight months of 1956. This was about one-fifth below the high volume of starts last year for the same period, but approximately the same as the starts during the same months of the years, 1951–1954.

Another **Big Office Building**

by

AMERICAN BRIDGE

This imposing 30-story steel-frame structure is the latest New York office building to be fabricated and erected by American Bridge. Known as 425 Park Avenue, it fronts 201 feet on the avenue, 146 feet on Fifty-fifth Street and 132 feet on Fifty-sixth Street.

Approximately 5,900 tons of structural steel went into its framework. Field connections were made with high strength bolts, regular bolts and welding—which held construction noises to a minimum.

Working in crowded areas like this is routine to American Bridge. From the old Flatiron Building in 1901, to the Empire State Building in 1930, to the Socony Mobil Building in 1956, American Bridge has become more and more dexterous in handling big jobs in big cities.

The experience thus acquired over the past fifty-five years qualifies American Bridge to handle any type of structural steelwork with skill and speed. For more information concerning our ability to help you with your construction problems, contact the nearest office, or write direct to our Pittsburgh headquarters.

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UNITED STATES STEEL

Metropolitan Water District Speeds Colorado Aqueduct Work

With voters' approval of a recent proposition for bringing Southern California its full allotment of Colorado River water, the Metropolitan Water District of Southern California is pushing its huge aqueduct construction program. The initial construction phase was completed in 1941. The second phase of expansion, now under way and scheduled for completion in five or six years, will bring the aqueduct to its full capacity of one billion gallons daily. Work to be done includes installation of 15 additional pumps in the five pumping stations to bring water over the mountains; addition of 47 new siphons to bring water across canyons and washes; doubling storage capacity of Lake Mathews; and enlarging Weymouth Softening and Filtration Plant. Typical of the terrain that must be traversed by the distribution lines is this 72 percent grade on the lower feeder about 4,000 ft below the west portal of San Juan tunnel. Each of the 12-ft lengths of 9-ft-dia pipe weighs 19½ tons. Photo courtesy "Colorado River Aqueduct News."

N. G. Near's N* COLUMN

R. ROBINSON ROWE, M. ASCE

"All smiles, aren't you, Joe?" Did you win an election bet? Or did you decipher the decor of our proposed annex?"

"I did the mathematical part, Professor," bragged Joe Kerr modestly. "Here are the three steps:

ASCE	9S13	9813
AIEE	9I33	9733
ASME	9SM3	9843
AIME	9IM3	9743
AIChE	9I1h3	97103
CENTER	13NT35	136235

"The 10 digits have to be substituted for the 10 different letters without duplication so as to justify the summation. The sum of 4 numbers under 10,000 and one under 100,000 must give a 6-digit number under 140,000, so C = 1 and E < 4. E = 0 would make E = R and E = 1 would make E = C, so E = 2, 3. Then with the sum greater than 120,000, A = 8, 9. Also, adding the tens column with a carryover of one told me that 2M + h = 8, 18."

"Joe's unusually academic or pedagogic tonite," mused Cal Klater.

"No heckling from the audience, please," begged Joe. "From here on I resorted to some very clever guesswork. Trying the bigger numbers first, I let A = 9 and E = 3, making R = 5 at the second step (see above). To make 2M + h = 8 or 18, without using 1, 3, 5 or 9 again, I let M = 4, h = 0, and the rest was easy.

"That is, except for decoding the sign on the elevator tower with the same code, which gave ARCMTAHMETAHSCSAIN. Maybe this is the Welsh word for transitman, or maybe its an anagram for Mathematicharscans, if there is any such word."

"There isn't," snorted Cal. "You were doing all right at the second step. My wife was looking over my shoulder when I got that far and, being a crossword fan, began looking for an 18-letter word beginning ARC. . . She said all the long words began ARCH . . ., so I called h = 4, making M = 2 and she had ARCHMA.HEMA . . C.A . . with I,N,S and T to fill in. She yelled, 'Archmathematicians' and I proved it with the sum:

$$\begin{array}{r} 9613 \\ 9833 \\ 9623 \\ 9823 \\ \underline{98143} \\ 137{,}035 \end{array}$$

I also proved this and Joe's were the only solutions to the summation."

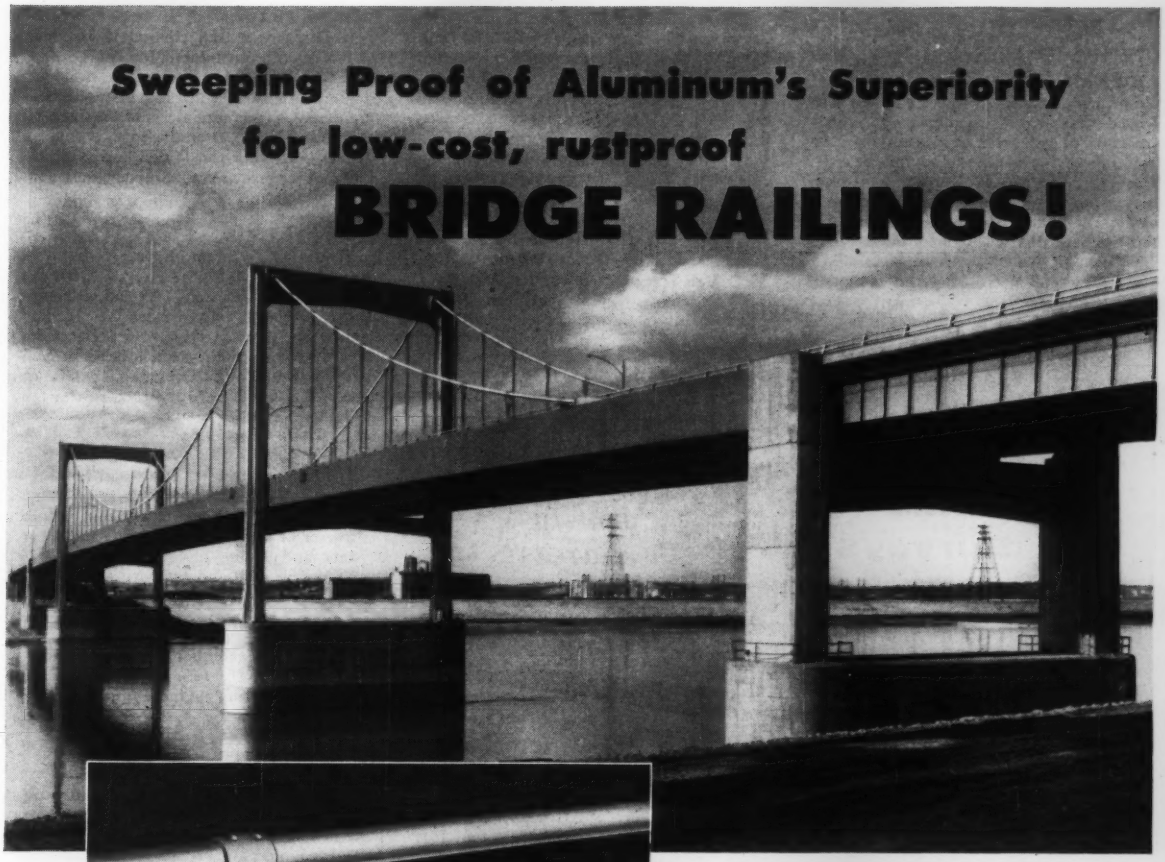
"And I salute you as an archmathematician, in one word, for an archmathematician would be a sly roguish one.

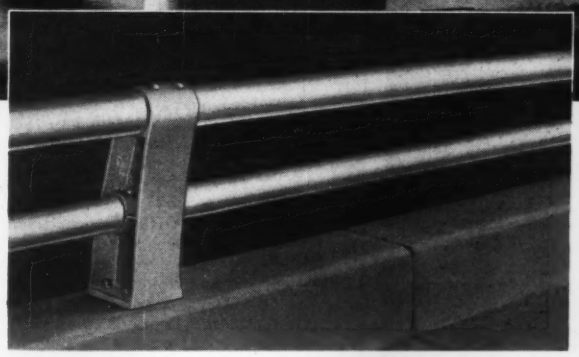
"This being Interstate Highway Week, it was fortuitous to hear Professor Gorithm propound a highway problem this afternoon. I have persuaded him to tell it to the rest of you. Are you ready, Al?"

"Always ready, Noah. The Minnekota Turnpike boomed so fast that we were swamped by the rush of concrete specimens. The first 121 cylinders were tagged as coming from 6 residencies in lots of 10 to 50, but didn't state the method of curing, and I knew that some residents still didn't have facilities for the specified wet curing. Wet-cured specimens usually weigh 31 lb and dry-cures 30 lb, but my scales hadn't arrived. So I ordered an assistant to make a weight check on a public scale which charged $1.00 per weighing. What did this cost me, his name being McTavish?"

[*Archmathematicians were: Kum Pewter (Walter Steinbruch), Andrew Pickett, Bernard Gutterman, Double-you Double-you (Walter Weiskopf), Thatchrite (Guy C. Thatcher), Pusse J. Retlaw (R. E. Vurst), S. L. Dum (Thomas Borman), S. K. Rueball (Keith Jones), Flo Ridan (Charles Edson), Donald Milks, Lord Byron (S. Byron Folk), H. Francis Finch, Al Gorithm (see below), Carl Oustad, Mrs. Daniel Van Voorhis, Si Ferncode (Wm. F. Saunders), O'Kay (Otto Koch), and Robert W. Woodbury. Guest Professor Al Gorithm is, or are, the collaborators Lawrence E. Goodman and A. R. Robinson.*]

Sweeping Proof of Aluminum's Superiority for low-cost, rustproof BRIDGE RAILINGS!





Reynolds Aluminum Guard Rails on Paseo Trafficway between North Kansas City and Kansas City, Missouri.

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For quick reference, see catalog $\frac{5a}{Re}$ *in Sweet's Architectural File.*

REYNOLDS ALUMINUM

See "CIRCUS BOY", Reynolds new dramatic adventure series, Sundays, NBC-TV Network.

News of Engineers

(*Continued from page 28*)

Hugh Barnes has been appointed Western regional manager of the new Los Angeles regional office of Portland Cement Association, organized to supervise its district offices in Los Angeles and Seattle, Wash. **John M. McNerney** has been chosen to succeed him as district engineer. Mr. Barnes joined the association in 1937 and has been district engineer in charge of the Los Angeles office since 1942. Mr. McNerney has been with the company since 1941 serving as soil-cement paving engineer.

Murray D. Van Wagoner, former governor of Michigan, has been appointed to the Board of Directors of American Forging & Socket Co., of Pontiac, Mich. Mr. Van Wagoner is vice-president of Byrne Doors, Inc., of Ferndale, Mich. He has been Michigan Highway Commissioner, and director of the United States Military Government of Bavaria.

M. D. Van Wagoner

Robert I. Patten, Jr., has been appointed general manager and partner in the firm of Paddock Pool Builders, Inc., of Atlanta, Ga. Mr. Patten will work in the engineering and design field in the construction of municipal, commercial, and residential swimming pools. For the past four years he has been with the Wallis Supply Company of Gainesville as engineer and general manager.

Frederick William Epps, veteran of some 30 years with the Kansas Highway Commission and since 1930 maintenance bridge engineer, retired recently. He first joined the Kansas Highway Department in 1918 as bridge engineer, leaving in 1923 to join the Kansas Engineering Co. on consulting work. He returned to the Department in 1930.

Walter H. Jollie, former sanitary engineer for the Illinois Department of Public Health, and **Robert T. Richey,** former director of sanitary engineering for Shaw, Metz and Dolio, have joined Baxter & Woodman, civil and sanitary engineers of Crystal Lake, Ill.

Victor D. Macomber and **Fred S. Faber, Jr.,** announce the formation of a partnership as consulting engineers under the firm name of Macomber & Faber, with offices at 1824 N. 4th St., Harrisburg, Pa.

Henry J. Walocha was recently appointed an associate in the firm of Victor Gruen & Associates, planners, architects and engineers. Mr. Walocha has been with firm since 1954 and is head of the structural department in the firm's Los Angeles main office.

Howard P. Hall recently took over new duties as dean of engineering at Robert College, Istanbul, Turkey. An authority on soil mechanics, Professor Hall has been associate professor of civil engineering at the Northwestern Technological Institute since 1939, except for the time out to serve during World War II with the U. S. Army Corps of Engineers.

Stephen H. Meem has been named new managing director of the new Engineering and Research Division of the American Road Builders' Association, Washington, D. C. His new work will be concerned with practical application of research findings and other technical data to encourage improved construction and maintenance methods. Until recently Mr. Meem was assistant general manager of the Richmond–Petersburg Turnpike Authority at Richmond, Va.

Robert Marks, formerly engineer with Bechtel Corp. in Los Angeles, announces the formation of a partnership with **Joseph Porterfield** for the practice of structural engineering. The office will be located at 1109 North Vermont Avenue, Los Angles, Calif.

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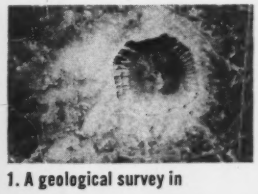
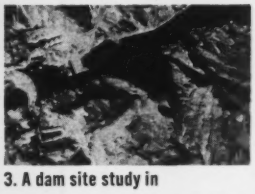


1. A geological survey in _____.

2. A town planning survey in _____.



3. A dam site study in _____.

4. An airborne magnetometer survey in _____.

In every part of the United States—and all over the free world—engineers, city planners and exploration men are finding that Fairchild surveys are fast, accurate and less expensive.

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Harrison H. Roberts has been appointed to the newly created post of manager of engineering and foreign operations for Intrusion-Prepakt, Inc. For the past two years he has been chief engineer for the Walsh Canadian Construction Co. on an excavation contract for the St. Lawrence Seaway Authority.

Harrison Kane has been appointed assistant professor of civil engineering at Pennsylvania State University. Mr. Kane was formerly a structural engineer with Parsons, Brinckerhoff, Hall and Macdonald of New York.

Among engineers appointed by the U. S. Soil Conservation Service to participate in the Water Resources Seminar now being conducted at Harvard University are: **Blair T. Bower,** engineer with the Bechtel Corp., Vernon, Calif., **William W. Reedy** of the Bureau of Reclamation; and Professors **Gordon Fair** and **Harold A. Thomas, Jr.,** of the Harvard Engineering faculty.

George R. Halton has been appointed head of the Highways and Airport Division of the Kuljian Corporation in Philadelphia, Pa. He will supervise the planning and development of airports, highways, expressways, and their appurtenant structures and facilities. An expert in soil mechanics, Mr. Halton is head of the George R. Halton Engineering Consulting firm of Newark, N. J.

Harold H. Jones is one of the five new members elected to the Board of Directors of Fay Spofford & Thorndike, Inc., Boston. The others (announced in the August issue) are **Burdette K. Beebe, Fozi M. Cahaly, Edward C. Keane** and **Leon B. Turner.**

Mason C. Prichard has resigned as executive vice-president of the Foundation Co., of New York to return to the Oman Construction Co., New York City, as vice-president. He is a Director of ASCE and a retired Colonel in the U. S. Army Corps of Engineers.

Robert S. Rowe was recently appointed chairman of the Department of Civil Engineering at Duke University, in Durham, N. C. Dr. Rowe has been associate professor of civil engineering at Princeton since 1946, except for leaves of absence for graduate study at Columbia and Yale.

Gustave D. Houtman of G. D. Houtman and Son, Civil Engineers of Media, Pa., announces the purchase of the engineering practice of Over and Tingley of Haverton, Pa. The Over and Tingley firm was started in the early 1920's, and has been active in land development, surveying and municipal engineering work.

Penn P. Livingston has just returned from India where he completed an 18-month contract as senior hydrologist for the Ralph M. Parson's Co. on a $7,000,000 test drilling program to find ground water for irrigation. He will be available for consultation on general hydrology, especially ground-water problems. Mr. Livingston's address is RR No. 7, Box 188, Lake Austin, Tex.

Renville S. Rankin, director of the sanitary technical division of Dorr-Oliver Inc., at Stamford, Conn., retired on October 1, after 27 years of service. He will remain with the company in a consulting capacity on sanitary engineering matters. **Fred G. Nelson** will succeed Mr. Rankin as director, and in his new position will have overall responsibility for the development, design, and engineering of all Dorr-Oliver sanitary equipment. Mr. Nelson was previously manager of the Western Sanitary Division at Oakland, Calif.

Robert D. Dikkers has been appointed an assistant engineer for the National Concrete Masonry Association at its Chicago headquarters. Mr. Dikkers was previously a junior civil engineer with the Harza Engineering Company of Chicago.

Ralph N. Shepard, engineer of construction and design with Carbide and Carbon Chemical Corp., South Charleston, W. Va.,

(Continued on page 94)

THE EXPERIENCE AND KNOW-HOW OF 54 TOP CIVIL ENGINEERING CONSULTANTS AT YOUR FINGERTIPS IN

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- ☐ Collimeters
- ☐ Stands
- ☐ Tripods
- ☐ Repair of present instruments, (any make)

NAME.....

ADDRESS.....

.....

News of Engineers

(*Continued from page 93*)

has retired after more than 38 years of service with units of the Union Carbide and Carbon Corp. During his long tenure with the company he was with Linde Air Products for 16 years and for 22 years with the Chemicals Company.

Richard N. Berry has been elected a member of the board of directors of Consumers Water Company and general manager and assistant to the vice-president in charge of operations at Portland, Me. Mr. Berry has been engaged in consulting engineering and management work for water utilities in Maine since 1951.

Benjamin F. Fairless, president of the American Iron and Steel Institute and retired head of the United States Steel Corp., was named by President Eisenhower as chairman of a citizens' committee to review foreign-aid programs. The new committee will be known as the President's Citizen Advisers on the Mutual Security Program.

Thomas J. Driscoll has been appointed Fox River valley field engineer for the Portland Cement Association, with headquarters in Appleton, Wis. He replaces Barry E. Brevik, who has retired after 30 years with the Association. Mr. Driscoll has been with the association since 1948.

Armour T. Granger, has assumed new duties as dean of the University of Tennessee College of Engineering. Since 1940 he has been head of the civil engineering department there. Professor Granger is a specialist in bridges and a former president of the Tennessee Valley Section.

Harold K. Friedland, former district airport engineer for the U. S. Civil Aeronautics Administration, announces the opening of an office for the general practice of civil engineering in Escondido, Calif. He will also serve as western associate engineer for Leigh Fisher & Associates of South Bend, Ind.

Emil C. Jensen, chief of the Engineering and Sanitation Division of the Washington State Department of Health, is the new vice-president of the Federation of Sewage and Industrial Wastes Associations. He will fill out the unexpired term of John W. Cunningham, who has resigned.

Casimir A. Rogus, director of engineering of the New York City Department of Sanitation, was honored by the American Public Works Association at its convention in Fort Worth, Tex., with presentation of the Charles Walter Nichols Award for outstanding and meritorious achievements in the public works field. Mr. Rogus has spent more than 27 years in government work.

George H. Lacy, recently retired chief civil engineer for the Houston division of the Gulf Oil Corp., has joined Portable Bridge and Equipment Co. of Houston. His major assignment is sales promotion of general fabrication items for the oil and heavy construction industries. Mr. Lacy is a past-president of the Houston Branch of the Texas Section.

Alfred C. Drake was recently promoted to the position of general construction superintendent of Electro Metallurgical Co. in North Madison, Ohio, a division of Union Carbide and Carbon Corp. Mr. Drake is responsible for the planning, scheduling, and management of construction of all of the plants and facilities of the Electro Co.

James H. Le Van, senior sanitary engineer with the United States Public Health Service, detailed to the FHA at Jamaica, N. Y., has been transferred to the newly established Health Research Facilities Branch in Bethesda, Md. His new address is National Institutes of Health, Division of Research Grants, Bethesda 14, Md.

Loris L. Gerber is vice-president in charge of engineering and production of the new Prescon organization formed by a merger of Prescon, Inc., and Prescon of Texas. He was formerly general manager in charge of administration and production of Prescon of Texas at Corpus Christi. **Willard C. Alexander** is one of his top engineering aides.

Harold L. Aitken, former state engineer of Nebraska and since 1953 executive assistant administrator for the Federal Civil Defense Administration at Battle Creek, Mich., has been named engineer in charge of the newly-opened Washington office of the Clarkeson Engineering Company, Inc., of Boston.

J. Morley English, international authority on structures, has been appointed to organize the Harvey Aluminum Structures, division of Harvey Machine Co., of Torrance, Calif. Dr. Morley is on leave from the University of California at Los Angeles, where he is associate professor of engineering.

Thomas F. Burris was recently appointed chief engineer of the Chesapeake and Ohio Railway, with headquarters at Huntington, W. Va. Mr. Burris is a 29-year veteran employee, and served until recently as chief engineer of the Southern region at Richmond, Va.

Russell E. Dukehart has taken over new duties as road and airport design engineer with the Benjamin E. Beavin Company, Consulting Engineers of Baltimore, Md. Mr. Dukehart has been employed by Associated Consulting Engineers of Baltimore.

DECEASED

Sylvester Clay Baker (M. '22), age 74, consulting engineer of Green Lake, Wis., died at his home there recently. A 1908 graduate of the University of Missouri, Mr. Baker spent 28 years of his career in railroad work. For seven years he was engineer with the United Railways Co., of St. Louis, and for 18 years engineer of maintenance of way and structures with the East St. Louis & Surburban Railroad Co. Later he was coordinator for Greeley and Hansen, consulting engineers of Chicago, on construction of Camp Forrest, and for Ferguson-Oman of Cleveland in the building of the Wolf Creek Ordnance Plant at Milan, Tenn.

William J. Barden (M. '23), age 86, retired Colonel, U. S. Army, died at his home in Washington, D. C., on October 2. A graduate of West Point Military Academy, class of 1894, he served in the Spanish American War, the Vera Cruz Expedition and World War I. He had been division engineer of the Northeast Division of the Corps of Engineers, and helped build Wilson Dam at Muscle Shoals, Ala. Colonel Barden retired in 1934 but was recalled to active duty in 1940 as district engineer for the District of Columbia. Since 1942 he had been a consultant for the Esso Shipping Co.

Haig M. Boyajohn (M. '19), age 71, president of Boyajohn and Barr, Inc., general contractors of Columbus, Ohio, died at his home in that city recently. For several years Mr. Boyajohn was manager of the Brayton Engineering Co., Detroit, on general contracting work, specializing in the design of large municipal and office buildings. He organized the firm of Boyajohn and Barr in 1922.

Ralph H. Burke (A.M. '10), age 72, city airport consultant and head of the Chicago engineering firm of Ralph H. Burke, Inc., died in Evanston recently. He was a graduate of Massachusetts Institute of Technology, class of 1906. Mr. Burke was associated with the City of Chicago Sanitary District from 1906 to 1920 as engineer and principal construction engineer, returning in 1934 to serve twelve years as chief engineer of the Park District. During the interim he was engineer and general superintendent of the T. J. Forschner Contracting Co. and its successor, the A. J. Forschner Construction Co. In 1946 he formed the Ralph H. Burke firm.

Harry Gilbert Burrowes (M. '09), age 78, retired consulting engineer of San Francisco, Calif., died there on August 19. A native of Mt. Vernon, N. Y., Mr. Burrowes spent his early career in railway, tunnel, and terminal construction work in the East. He served in World War I as a captain in the 25th Engineers and in the recent war as chief division engineer

(*Continued on page 96*)

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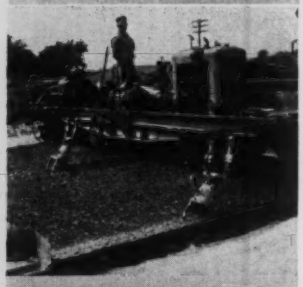
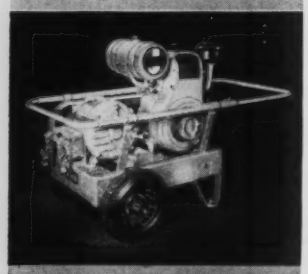


JACKSON SIDE FORM VIBRATOR

JACKSON VIBRATORY SCREED



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(*Continued from page 95*)

of the Defense Plant Corp. for the Western states. Until recently Mr. Burrowes had consulting offices in San Francisco.

Ralph Hughes Cahill (M. '26), age 65, manager of the village of Whitefish Bay, Wis., died there on August 10. Mr. Cahill received his degree from the University of Wisconsin in 1913. He was engineer in charge of design and construction for the Milwaukee Water Works from 1923 to 1927, and later was in practice with Charles A. Cahill & Sons, consulting engineers of Milwaukee. He had been village manager of Whitefish Bay since 1933.

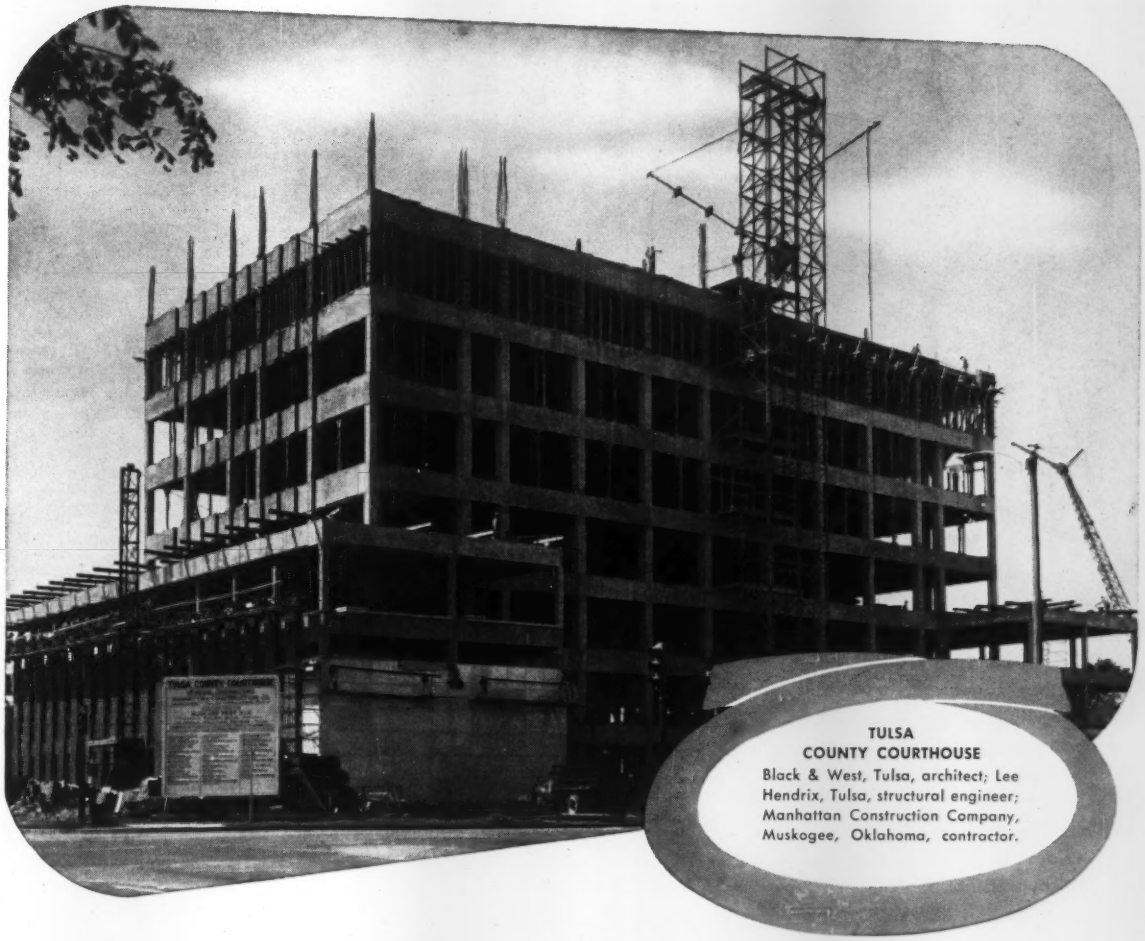
Selleck T. M. Carpenter (M. '31), age 72, president of Carpenter & Skaer Inc., of Buffalo, N. Y., died at his home there on September 13. In 1915 Mr. Carpenter joined the construction firm of B. I. Crooker as engineer and estimator, and in 1921 he became vice-president and secretary of the firm, under the name of Crooker and Carpenter, Inc. In 1928 the firm name was changed to Crooker, Carpenter and Skaer, Inc., predecessor to Carpenter & Skaer, Inc., with Mr. Carpenter as vice-president. He was a graduate of Webb Academy of Marine Engineering and Naval Architecture.

Donald O. Coe (M. '52), age 54, since 1952 chief of the Safety Branch of the Mississippi River Commission, died at his home in Vicksburg recently after a short illness. A 1926 civil engineering graduate of Denison University, he did graduate work at the University of Wisconsin and Temple University, and later was associated with Weston and Sampson, consulting engineers of Boston, Mass., as engineer and resident engineer. In 1940 he was appointed assistant Naval Architect in the U. S. Navy Department, transferring to the U. S. Engineer Office at Vicksburg in 1941.

William Neville Collier (M. '14), age 83, retired specialist in the design and construction of public buildings, died recently at his home in Long Beach, Calif. Mr. Collier's early career was spent in railroad work. From 1909 until his retirement in 1938 he was with U. S. Public Buildings, Treasury Department, which he served as superintendent of construction and, from 1924 on, as district engineer at Kansas City, Mo.

Allan Reginald Cullimore (M. '52), age 72, president emeritus of Newark College of Engineering, died at his home in South Orange, N. J., on September 20. Joining the Newark College faculty as executive head in 1920, he was instrumental in the planning and development of three new engineering buildings. Since his retirement as president in 1949, he had served as consultant in various educational, financial, and professional capacities. In his earlier career he was dean of engineering at the

(*Continued on page 98*)



TULSA
COUNTY COURTHOUSE
Black & West, Tulsa, architect; Lee Hendrix, Tulsa, structural engineer; Manhattan Construction Company, Muskogee, Oklahoma, contractor.

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The photo above shows the Tulsa County Courthouse, Tulsa, Okla., as it appeared when under construction. The completed building is 14 stories high. The floors are of ribbed concrete construction.

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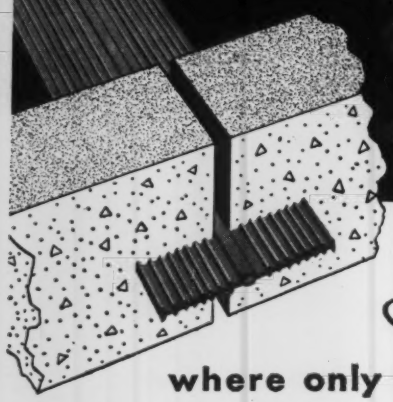

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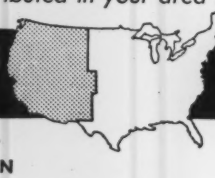

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(*Continued from page 96*)

University of Delaware and dean of the College of Industrial Science and acting president of the University of Toledo. He was a graduate of Massachusetts Institute of Technology, and a veteran of World War I, in which he served in the Sanitary Corps with the rank of major.

Lawrence Merton De Long (A.M. '50), age 41, for the past five years structural engineer with the Corps of Engineers at Portland, Ore., died at his home there recently. Mr. De Long received his B.S. in civil engineering from Oregon State College in 1938 and his M.S. from the University of Illinois in 1941. He had been with the Navy Bureau of Yards and Docks, conducting surveys in Guam and the Palau Islands, and served as structural engineer for the Portland (Ore.) Bureau of Buildings. Mr. De Long joined the Corps in 1951.

Arthur Herbert Diamant (A.M. '06), age 77, chief engineer on the construction of the Sixth Avenue Subway in New York City, died at his home there recently. A civil engineering graduate of the College of the City of New York, Mr. Diamant was vice-president of the Rosoff Subway Construction Co., Inc., and its successor, Samuel R. Rosoff, Ltd., for many years prior to his retirement in 1950. He had also been chief engineer of the Delaware and Northern Railway Co.

Daniel Mason Garber (M. '28), age 67, since 1947 head of the Mason Garber Construction Co., of Winston-Salem, N. C., died at his home there recently. For many years Mr. Garber was connected with the North-Eastern Construction Company of New York, which he served as vice-president of the North Carolina district and as director. Mr. Garber studied at the Virginia Military Institute and Columbia School of Mines and Engineering.

Clarence B. Goodwin (M. '27), age 66, retired city manager of San José, Calif., died at his home there recently. He was a graduate of Stanford University, class of 1913. After early work with the structural engineering firm of H. J. Brunnier, San Francisco, Mr. Goodwin served as superintendent of construction for the Federal Construction Co. He became assistant city engineer of San José in 1918, progressing to city engineer and city manager. He retired in 1946.

Philip Gray (A.M. '32), age 68, superintendent of the Crabtree Construction Co., West Palm Beach, Fla., died at his home at Lake Worth, Fla., recently. A specialist in difficult foundations and marine structures, Mr. Gray built the foundation for the New York City Municipal Building and was employed on the construction of

(*Continued on page 100*)

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(*Continued from page 98*)

the Hell Gate Bridge in New York and the Flagler and Lake Worth bridges in Florida. For a number of years he was president and chief engineer of the Gray Engineering and Construction Co., Inc., of Greenwich, Conn. He had been in Florida since 1941. He was a graduate of Cooper Union.

Howard John Grevenitz (J.M. '54), age 23, junior civil engineer with the Westchester County (New York) Department of Public Works and a resident of Long Island City, N. Y., died in an accident on September 3. A graduate of Cooper Union College, class of 1954, he had been associated with the Westchester Department of Public Works for the past two years.

Theodore Warren Hacker (M '31), age 64, partner in the engineering firm of Whitman, Requardt and Associates, Baltimore, died at his home at Gibson Island, Md., on September 22. A 1917 civil engineering graduate of Cornell University, Mr. Hacker had been with Whitman, Requardt most of the time since 1919. In 1934 he was put in charge of all the firm's construction work and carried on this phase of its activities until he was taken ill last spring. One of his major projects for the firm was the organization of survey parties, resident engineers and inspectors for the large Chemical Warfare Arsenals built by the United States Army at Edgewood, Md., and Huntsville, Ala. From 1931 to 1934 he was retained by the Rockefeller Foundation for sanitary work and was stationed in Thailand as adviser on water supply to the Siamese Government.

George Wellington Hamilton (M. '30), age 76, consulting engineer of Washington, D. C., died at his home there on August 30. Mr. Hamilton was a fellow and charter member of the AIEE and had just become a life member of ASCE. He had worked for 56 years in the United States and South America in major phases of electric utilities, in the developing, designing, constructing, operating, administering and marketing of power. From 1919 to 1933 he was vice-president in charge of hydraulics and electrical engineering for the Middle West Utilities Co. of Chicago.

John Newton Harris (A.M. '46), age 49, manager and secretary of the Culpeper Building and Supply Corp., of Culpeper, Va., died there recently. He was a graduate of Virginia Mechanical Institute. From 1926 to 1948 Mr. Harris was with the Virginia Department of Highways, which he served as bridge designer, designer, project engineer, and resident engineer. In 1948 he joined the construction firm of Culpeper Building and Supply. In World War II Mr. Harris served as a lieutenant colonel in the Army Corps of Engineers.

August L. Hausmann (A.M. '31), age 63, designer with Corbett, Tinghir & Co., of New York City, died at his home at Cliffside Park, N. J., recently. A native of Germany, Mr. Hausmann graduated from the Polytechnic University of Hanover in 1921 and was engaged in structural steel and steel bridge work until 1927 when he came to the United States. His work here had included design and checking for the Electric Bond and Share Co. and the American Gas and Electric Co., both of New York City. He had been with Corbett, Tinghir since 1951.

Walter Monroe Jarvis (M. '36), age 60, construction engineer with the Corps of Engineers at Oak Ridge, Tenn., died at his home there recently. Mr. Jarvis was associated with Stone & Webster at Oak Ridge, Tenn., prior to joining the Corps of Engineers in 1946. Earlier he had been associated with the Kentucky State Highway Department as district engineer and engineer in charge of maintenance. He studied at the University of Kentucky and was a veteran of World War I.

William J. H. Manning (A.M. '20), age 65, division engineer with the Delaware and Hudson Railroad Corp. at Plattsburg, N. Y., died there recently. He was a civil engineering graduate of Rensselaer Polytechnic Institute, class of 1911. Mr. Manning joined the Delaware and Hudson Railroad in 1919, and since 1925 had been division engineer in charge of the Champlain Division.

David Curtis Martin (M. '52), age 51, structural designer for the General Electric Co., Schenectady, N. Y., died there recently. A 1933 graduate of Manhattan College, Mr. Martin had been with General Electric since 1942. As town engineer for Rotterdam, N. Y., for five years, he designed the town hall and other municipal structures. His specialty was the design of concrete foundations for large electrical installations, and his projects included the foundation for the 20,000-kva motor at California Institute of Technology.

Harold J. McCoy (M. '45), age 65, consulting engineer of Spokane, Wash., died at his home there on August 13. A specialist in lumber mills and lumber products, Mr. McCoy had been in practice in Spokane since 1943. Earlier he had a consulting practice in Portland, Ore. For a number of years he was assistant manager of the Klamath Falls Branch of the Weyerhaeuser Lumber Co. at Klamath Falls, Ore. He was prominent in the Spokane Section, which he served as president in 1948.

Clarence McDonough (M. '29), age 66, president and director of the Foundation Company of New York City, died suddenly at his home in that city on September 20. Mr. McDonough graduated from Massachusetts Institute of Technology in 1912 and joined the Foundation Company

the next year. He was engineer and district manager for the Pittsburgh district until 1926, when he was made chief engineer for foreign countries. Mr. McDonough was general manager and chief engineer for the Lower Colorado River Authority from 1935 to 1940. He returned to the Foundation Co. in 1943 as vice-president and director, and became president in 1953. He also had been president of the Jersey City Liberty Terminal Corp.

John Francis McGrath (M. '48), age 32, civil engineer with the Lago Oil & Transport Co., Ltd., in Aruba, Netherlands West Indies, died there recently. A graduate of the University of South Carolina, class of 1948, Mr. McGrath had been with Lago Oil & Transport Co., Ltd., since his graduation.

Granville Parker (A.M. '30), age 57, for the past two years superintendent of the engineering construction and maintenance department of West Australian Petroleum Pty., Ltd., Perth, Western Australia, died in Hong Kong, China, on June 7. In his early career Mr. Parker held various engineering positions in the United States and China. From 1938 to 1943 he was associated with the Colombian Petroleum Co. in Calcutta, and from 1947 to 1954 he was chief construction engineer for the Texas Petroleum Co. in Bogota, Colombia. He served as captain in the U. S. Army Corps of Engineers in World War II.

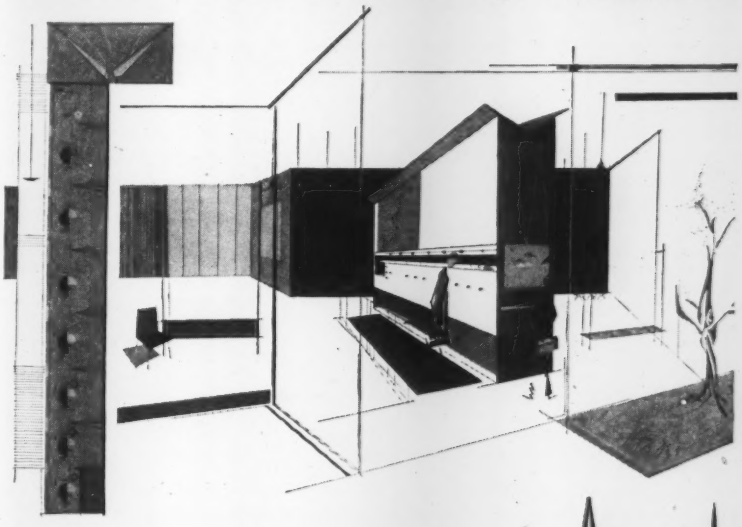
Wilbur L. Sharp (M '48), age 66, retired rate engineer for the Portland General Electric Company, Portland, Ore., died at his home there recently. Mr. Sharp retired last December from active management of his department after 35 years of service. He had continued to serve the company in a consulting capacity.

Sheldon B. Shepard (A.M. '21), age 68, retired engineer of St. Petersburg, Fla., and Twig, Minn., died recently in a Duluth, Minn., hospital. From 1926 to 1938 Mr. Shepard was highway engineer for St. Louis County, Mo. During World War II he was with the Army Corps of Engineers at Omaha, Nebr., engaged in construction of airbases. After the war he taught engineering at Oklahoma A. & M. College for two years. A graduate of Ohio State University, Mr. Shepard had early experience in the New York and Ohio highway departments.

Joseph G. Shryock (M. '23), age 75, retired president of the Belmont Iron Works in Philadelphia, Pa., died at North Coway, N. H., recently. A graduate of Pennsylvania Military Institute, class of 1900, Mr. Shryock had been a steelmaker and expert on bridge design for 50 years. He started his career with the Pencoyd Iron Works and the Virginia Bridge Co., of Roanoke, Va., joining Belmont in 1904. He was vice-president of Belmont from 1926 to 1940, and presi-

(Continued on page 102)

MARS outstanding design **SERIES**



chef-less restaurant

This concept of Sue Vanderbilt, Pratt industrial-design graduate now designing GM auto interiors, would assemble a whole meal and cook it by microwave in a few seconds. Customer would merely check picture menu, insert money, push buttons. By the time he reached the far end of the counter the meal would be waiting, piping hot. All components already exist.

Many designs that will make news tomorrow are still in the "bright idea" stage today. No one knows which will flower into reality. But it will be important in the future, as it is now, to use the best of tools when pencil and paper translate a dream into a project. And then, as now, there will be no finer tool than Mars—sketch to working drawing.

Mars has long been the standard of professionals. To the famous line of Mars-Technico push-button holders and leads, Mars-Lumograph pencils, and Tradition-Aquarell painting pencils, have recently been added these new products: the Mars Pocket-Technico for field use; the efficient Mars lead sharpener and "Draftsman's" Pencil Sharpener with the adjustable point-length feature; and — last but not least — the Mars-Lumochrom, the new colored *drafting* pencil which offers revolutionary drafting advantages. The fact that it blueprints perfectly is just one of its many important features.

The 2886 Mars-Lumograph drawing pencil, 19 degrees, EXEXB to 9H. The 1001 Mars-Technico push-button lead holder. 1904 Mars-Lumograph imported leads, 18 degrees, EXB to 9H. Mars-Lumochrom colored *drafting* pencil, 24 colors.

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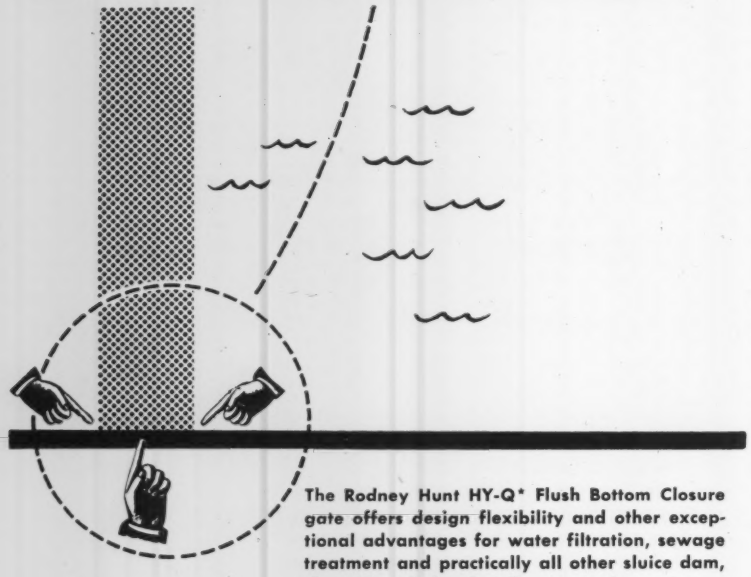
seats flush on the bottom of the channel!



The Rodney Hunt HY-Q* Flush Bottom Closure gate offers design flexibility and other exceptional advantages for water filtration, sewage treatment and practically all other sluice dam, channel and chamber flow control.

1. You get maximum flow because there is minimum turbulence at the point of greatest head.
2. You get *complete* drainage naturally; no need for pumps and piping to get out water trapped behind a sill.
3. You get maximum clear opening because full flow at every raising of the gate sweeps the channel clear of silt and debris.
4. You get maximum hydraulic gradient because the HY-Q gate seats at the lowest level of the channel.

Send for a new 12-page catalog – No. 75 – giving complete description and specifications of the patented Rodney Hunt HY-Q Flush Bottom Closure Sluice Gate.

*HY-Q is a trademark of Rodney Hunt Machine Co.

RODNEY HUNT MACHINE CO.
Water Control Equipment Division
86 LAKE STREET, ORANGE, MASSACHUSETTS, U.S.A.

RODNEY HUNT®

Deceased

Continued from page 101)

dent of the company until his retirement in 1950. He was the inventor in 1933 of the Belmont interlocking channel floor.

John Thomas Smith (M. '23), age 78, consulting engineer of Montevideo, Uruguay, died at his home there recently. A graduate of the University of Uruguay in 1901, Mr. Smith later received a certificate from the École Nationale des Ponts et Chaussees, Paris. Before entering private practice in 1940, Mr. Smith had been designer and constructor of a state bridge at Carmelo, Uruguay; director and vice-president of State Electrical Power Stations, Uruguay; and member of the Uruguayan Committee of the International Electrotechnical Commission. He had also been chief of a pavement company at Asfaltadora, Uruguay.

John Laurence Steward (A.M. '29), age 72, retired engineer and superintendent in charge of the Gas Depletion Department of the United Fuel Gas Co., Charleston, W. Va., died recently at Lemon Grove, Calif. From 1913 to 1917 Mr. Steward was in private practice, and for the next two years was resident engineer and office engineer for the Houston Coal Co., at its Elkhorn and Kimball, W. Va., plants. Mr. Steward joined United Fuel in 1919, working as field engineer in West Virginia, Kentucky, and Ohio.

Henry F. Stubbs (M. '43), age 62, consulting engineer of Houston, Tex., died at his summer home in Durango, Colo., recently. From 1948 to 1954 Mr. Stubbs was general manager and vice-president of the Frederick Snare Corp. on the west coast of South America. Earlier he had been associated with the Ambursen Engineering Corp. as chief engineer on the construction of the Possum Kingdom Dam, and with the Arundel Corp. on construction of roads in Puerto Rico.

Sidney J. Williams (M. '22), age 70, assistant to the president of the National Safety Council, Chicago, and dean of the traffic safety movement in the United States, died in Evanston, Ill., on August 5. Mr. Williams received two degrees from the University of Wisconsin, and after graduation became engineer of the Wisconsin Industrial Commission. In 1918 he joined the National Safety Council as chief engineer, taking charge of the Council's traffic safety program when it was launched in 1924. Since 1945 he had been assistant to the president of the Council. A national authority on traffic safety, he had been an adviser on safety matters to Presidents of the United States, to Congress, and to federal agencies.

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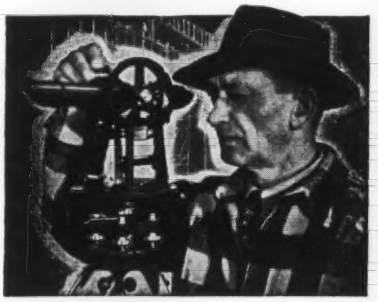

Shown, model 7014 with "A" standard. Model 7014 same unit with "U" standard, also available.

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RECENT BOOKS

(added to the Engineering Societies Library)

Rural Water Supply and Sanitation

Forrest B. Wright is the author of a practical guide to the design and installation of water systems, pumping equipment, plumbing systems, and sewage disposal systems for the farm or country home. A special feature is the inclusion of detailed instructions for carrying out fifteen typical jobs. (Second edition, 1956, John Wiley and Sons, Inc., 440 Fourth Ave., New York 16. 347 pp., $4.96.)

Engineering as a Career

This book by Ralph J. Smith introduces the beginning engineering student to the nature of the profession, to the type of studies he will be engaged in during his four years of college, and to selected topics in civil, electrical, and mechanical engineering. The qualifications, duties, and responsibilities of the engineer are indicated, and the profession is described both in terms of the major branches and in terms of functions—research, design, construction, management, etc. Materials, mechanics, thermodynamics, electrodynamics, and engineering economy are the engineering subjects introduced. (McGraw-Hill Book Co., Inc., 330 West 42nd St., New York 36. 1956. 365 pp., $4.75.)

Engineering Mechanics

The fourth edition of this standard text aims, like preceding editions, to acquaint the student with as many general methods of attack as possible, and to illustrate the application of these methods to practical engineering problems. In preparing the new edition, the authors have endeavored to simplify the presentation and have de-emphasized the algebraic treatment of problems by giving them with numerical data and numerical solutions. The authors are S. Timoshenko and D. H. Young. (Fourth edition, 1956, McGraw-Hill Book Co., Inc., 330 West 42nd St., New York 36. 478 pp., $7.50.)

Symposium on Atmospheric Corrosion of Non-Ferrous Metals

This symposium contains a report on a twenty-year testing program conducted by the ASTM, and nine papers based, mainly, on the results of the tests. The materials covered are copper and copper alloys, aluminum, magnesium coupled to other metals, rolled zinc, lead, tin, and nickel. (Published by the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. 1956. 158 pp., $2.75.)

(Continued on page 104)

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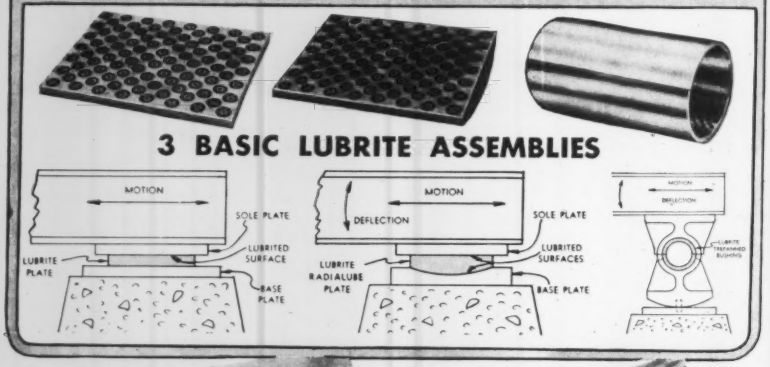

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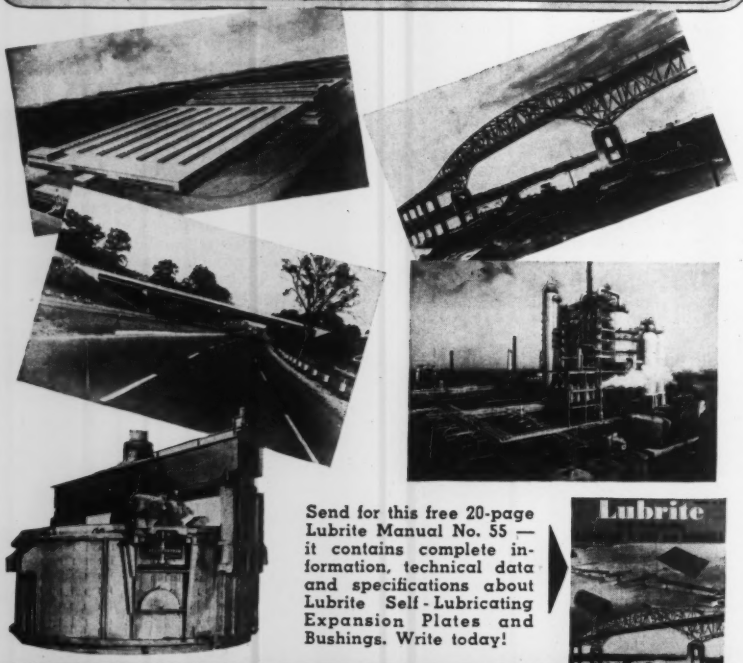

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Recent Books

(*Continued from page 103*)

Progress in Nuclear Energy

Series I—Physics and Mathematics, Vol. I

This volume, edited by R. A. Charpie and others, contains critical summaries of data on fission physics made available at the International Conference on the Peaceful Uses of Atomic Energy. Of the twelve papers included, four deal with the following subjects in basic reactor physics: homogeneous critical assemblies; zero energy studies on fast reactor; heterogeneous methods of reactor calculations; and theory and experiment of highly enriched intermediate and thermal assemblies. Other papers deal with neutron scattering and absorption, properties of fissionable materials under neutron bombardment, and delayed neutrons. (McGraw-Hill Book Co., Inc., 330 West 42nd St., New York 36. 1956. 398 pp., $12.00.)

Non-ASCE Meetings

American Institute of Chemical Engineers. Annual meeting at the Statler Hotel, Boston, Mass., December 9–12. Information from AIChE, 25 W. 45th Street, New York, N. Y.

American Institute of Steel Construction. Eight remaining one-day conferences on Plastic Design in Structural Steel will be held at the following universities under the sponsorship of the American Institute of Steel Construction: University of Southern California, Los Angeles, November 12; University of California, Berkley, November 14–15; University of Washington, Seattle, November 16; University of Oklahoma, Norman, November 20; University of Texas, Austin, December 3; Southern Methodist University, Dallas, December 4–5; and the University of Houston, Houston, December 7. Inquires should be addressed to Mr. W. G. Keat, 981-B Union Trust Building, Pittsburgh 19, Pa.

American Road Builders Association. ARBA Convention and Road Show at the International Amphitheatre in Chicago, Ill., January 28–February 2, 1957. Information from Harvey A. Scribner, Chairman of the Road Show Publicity Committee, 155 North Wacker Drive, Chicago 6, Ill.

American Society of Mechanical Engineers. Twenty-second National Exposition of Power and Mechanical Engineering at the New York Coliseum, New York City, November 26–30. Information from International Exposition Company, 480 Lexington Ave., New York 17, N. Y.

International Road Federation. Regional Conference of International Road Federation at Guatemala City, Guatemala, November 26–28. Information from IRF, 1023 Washington Building, Washington 5, D. C.

National Warm Air Heating and Air Conditioning Association. Forty-third Annual Convention at the Netherland Plaza Hotel, Cincinnati, Ohio, November 28–29. Make reservation requests directly to the Netherland Plaza, Fifth and Race, Cincinnati 2, Ohio.

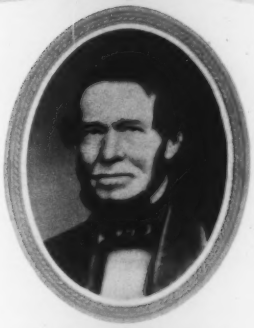
Society for the Advancement of Management. 1956 Annual Operations Research Conference Program at the Hotel Commodore, New York, N. Y., November 29–30. Information from SAM, 74 Fifth Avenue, New York 11, N. Y.

University of Illinois. Fourth Illinois Structural Engineering Conference in cooperation with the Division of University Extension at the university campus, Urbana, Ill., December 2–5. Information from R. K. Newton, Supervisor of Engineering Extension, 116 Illini Hall, University of Illinois, Urbana, Ill.

ALL OF IT STARTED
WHEN ICHABOD MET BEN

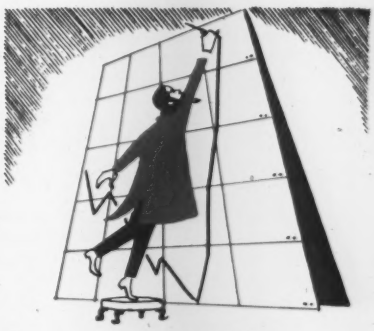
ICHABOD WASHBURN

Ichabod, Ichabod, how did you ken
The need for wire when you met Ben?
How did you know you'd not lose your shirts;
That ladies of fashion would hoop their skirts?



BENJAMIN GODDARD

Ichabod, Benjamin Goddard and you
Together made some products new.
How did you know that when sales took a drop
Washburn & Goddard would still be on top?



Ichabod. Benjamin. You made some dough
And finally merged with a worthy foe.
A. S. and W. now it became,
With products and sales, and world-wide fame.

Times have changed—wire uses, too,
But venerable A. S. and W.
Still remains foremost and best
In wire and wire products from Worcester, west.

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125
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UNITED STATES STEEL CORPORATION

READER: *If you would like information on steel reinforcement for concrete, you might find some on the next page. . . .*

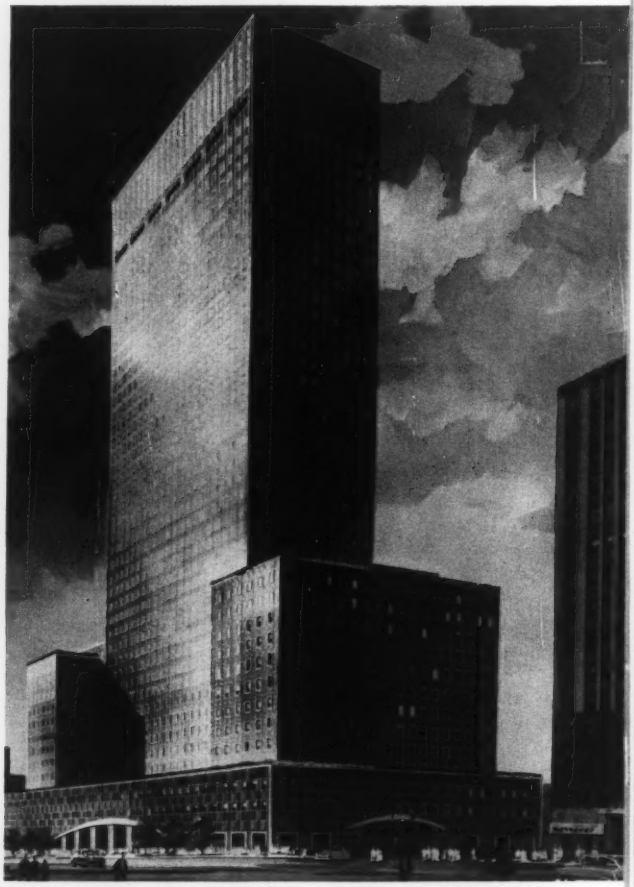
AMERICAN STEEL & WIRE DIVISION
UNITED STATES STEEL

ODE TO A ROAD...AND

When Ichabod and Ben used to ride through towns
They bounced and they jounced and they wore big frowns.
Today, they'd be happy, and free of all ire
On roads made of concrete, reinforced with wire.

A skyscraper builder by the name of Peter B. Grim
Forgot wire fabric and learned to his chagrin
That there's not a building tenant who doesn't deplore
An office that's built with a disappearing floor.

Quality American Welded Wire Fabric reinforcement controls cracking, and the longer reinforced concrete slabs provide a smoother riding pavement. Reinforced concrete pavements are 30% stronger than plain concrete pavements of equal thickness. Reinforced concrete pavements therefore last longer. You will find American Welded Wire Fabric adding strength to superhighways in Pennsylvania, Ohio, Indiana, and the City of Detroit. It is used with excellent results in asphaltic as well as Portland cement concrete. It comes in any size and style you need.

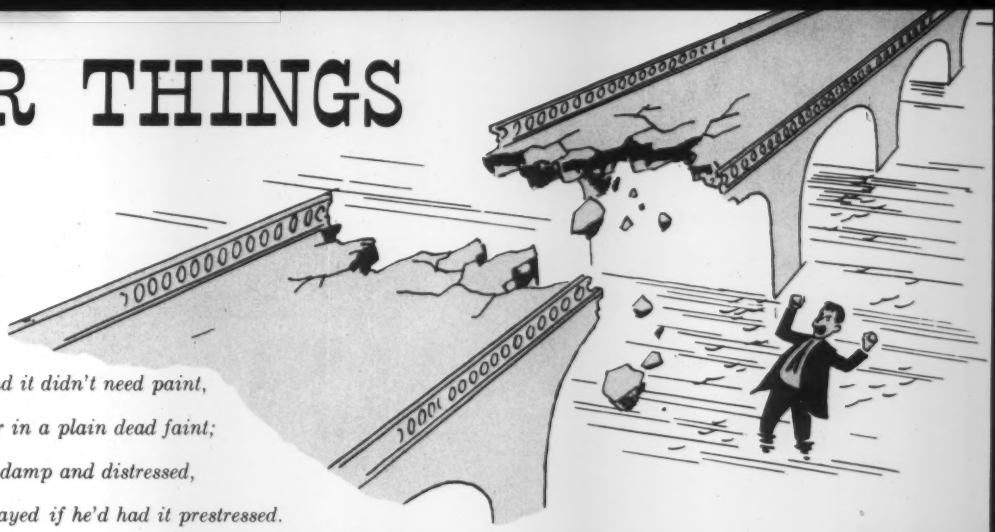


You need the extra strength of American Welded Wire Fabric reinforcement in any concrete floor. In beam and slab floors, like those in the Socony-Mobil Building shown above, and in pan and joint floors, American Welded Wire Fabric can be rolled into place quickly and easily . . . comes in any size or style you need.

USS AMERICAN WELDED WIRE FABRIC

USS

OTHER THINGS



There once was a bridge and it didn't need paint,
But collapsed in the river in a plain dead faint;
And so did the builder, all damp and distressed,
His bridge would have stayed if he'd had it prestressed.

Prestressed concrete now is being used in building floors, roofs, and beams, as well as in bridges. And in the Lincoln Tunnel Retaining Wall, shown at right, prestressed concrete panels form the wall. These panels were pretensioned with American High Strength Stress-Relieved Strand. American Steel & Wire also manufactures Super-Tens Stress-Relieved Wire for prestressing systems that use wire. American Steel & Wire was the first to manufacture a high strength strand for pretensioned, prestressed concrete. We make a complete line of sizes and types in both wire and strand.

OUR POINT IS THIS, *if you can stand some more*
When it comes to wire, we're a general store. For roads, for bridges, no matter what,
Of wire and wire products we've got a lot — So send the coupon without delay;
Just turn this page, and send it today.

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USS AMERICAN Super-Tens Stress-Relieved WIRE
—and—
AMERICAN HIGH STRENGTH STRESS-RELIEVED STRAND

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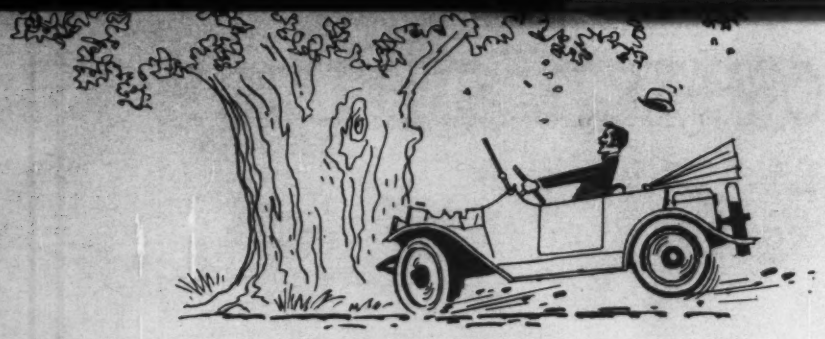

American Multisafty Cable Highway Guard is made from resilient steel cables, mounted on resilient spring-steel offset brackets. The combination gives vehicles two-way protection: it restrains a vehicle from plummeting off the berm, and cushions the shock of impact between vehicle and guard. It is easy to install, easy to maintain, and lasts a long time. It is the only guard rail that can be designed to provide definite miles-per-hour protection to the automobile driver. American Steel & Wire beam-type guard is also available for highway and parking lot installations.

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USS MULTISAFTY HIGHWAY GUARD

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- ☐ American Road Joints
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- ☐ American Welded Wire Fabric for Airport Runways
- ☐ American Wire and Strand for Prestressed Concrete
- ☐ General Catalog on Welded Wire Fabric
- ☐ Have your representative call.

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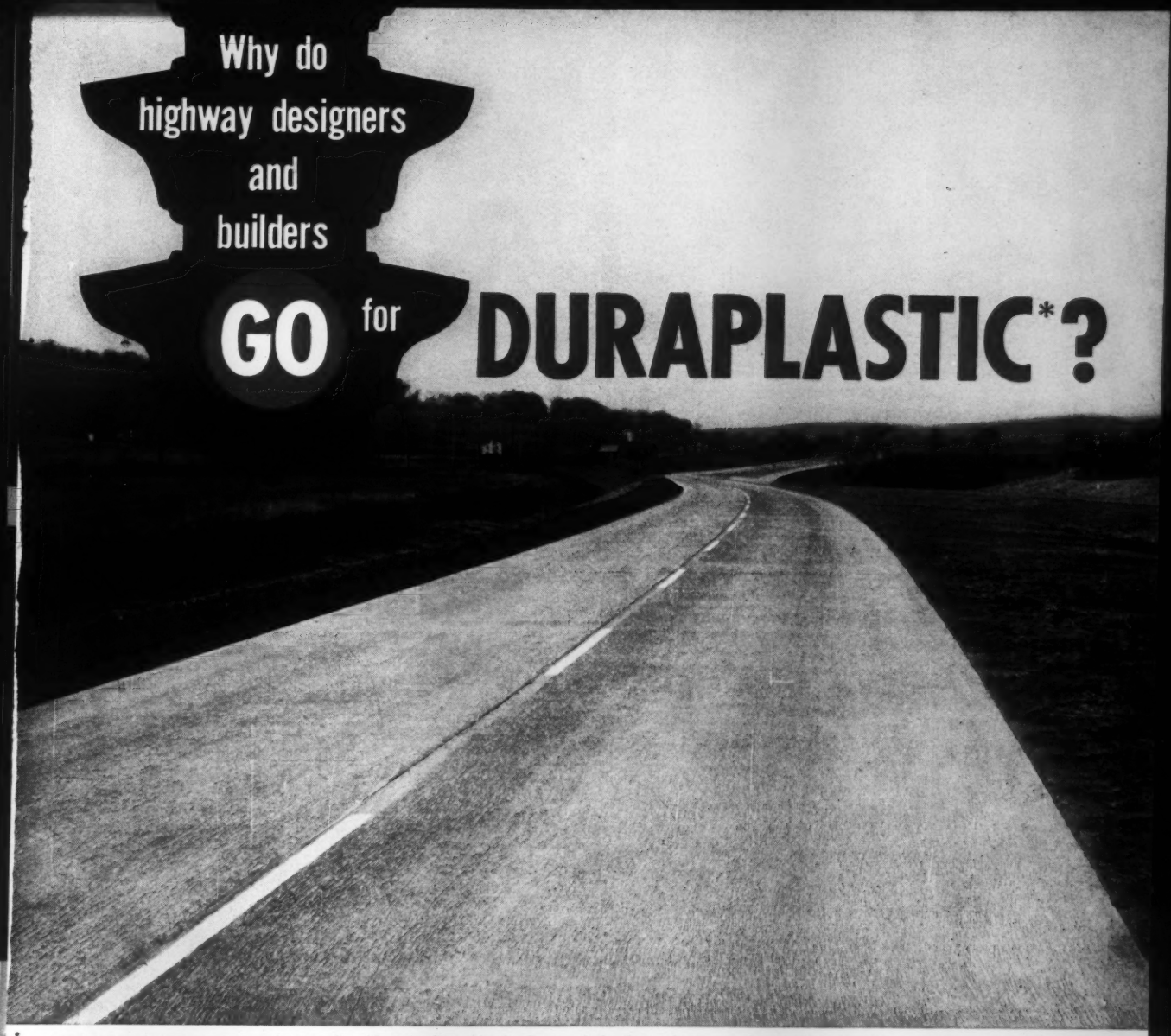

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because this concrete looks better, lasts longer!

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D-188

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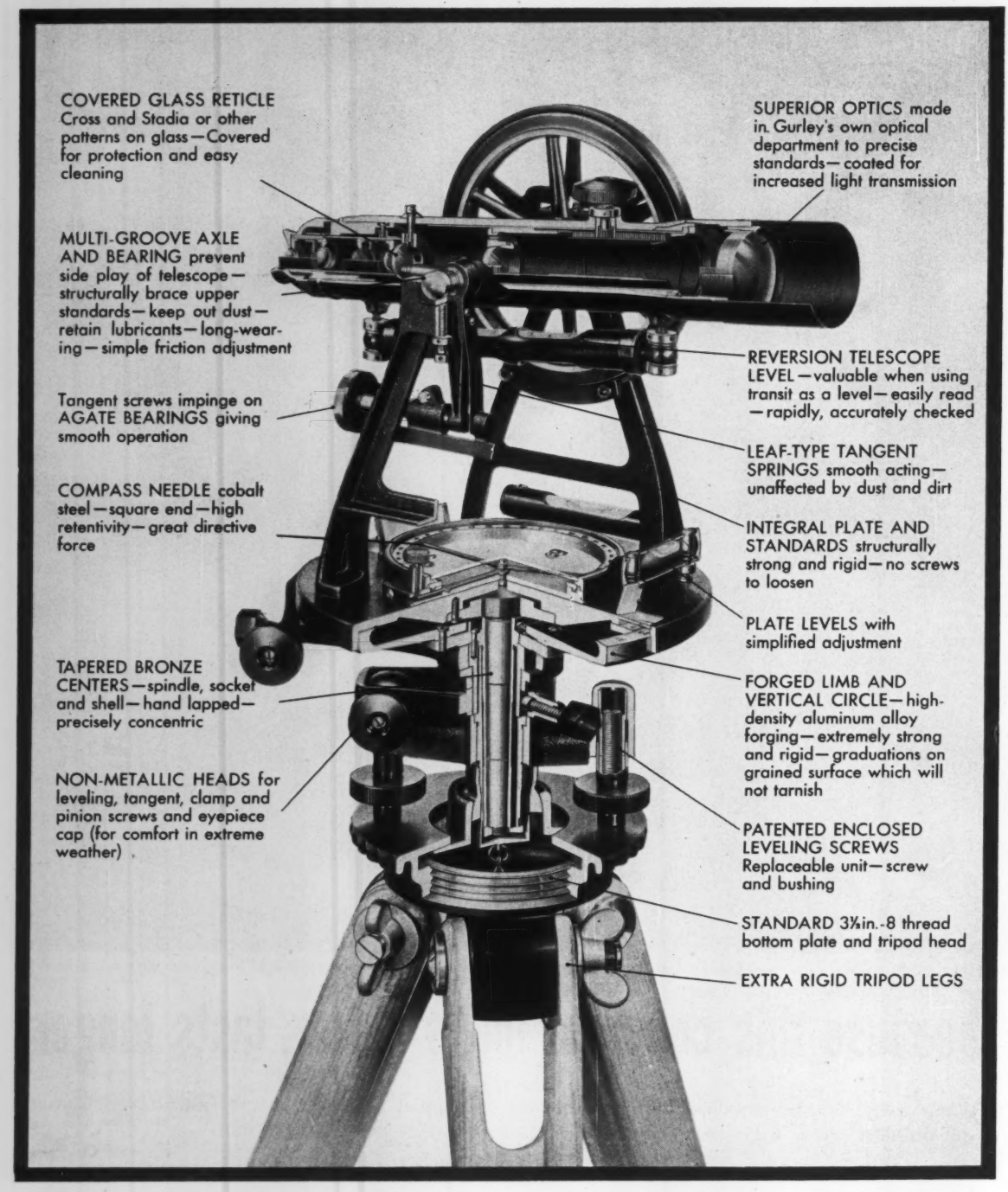
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MULTI-GROOVE AXLE AND BEARING prevent side play of telescope—structurally brace upper standards—keep out dust—retain lubricants—long-wearing—simple friction adjustment
Tangent screws impinge on AGATE BEARINGS giving smooth operation
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INTEGRAL PLATE AND STANDARDS structurally strong and rigid—no screws to loosen
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STANDARD 3⅛in.-8 thread bottom plate and tripod head
EXTRA RIGID TRIPOD LEGS

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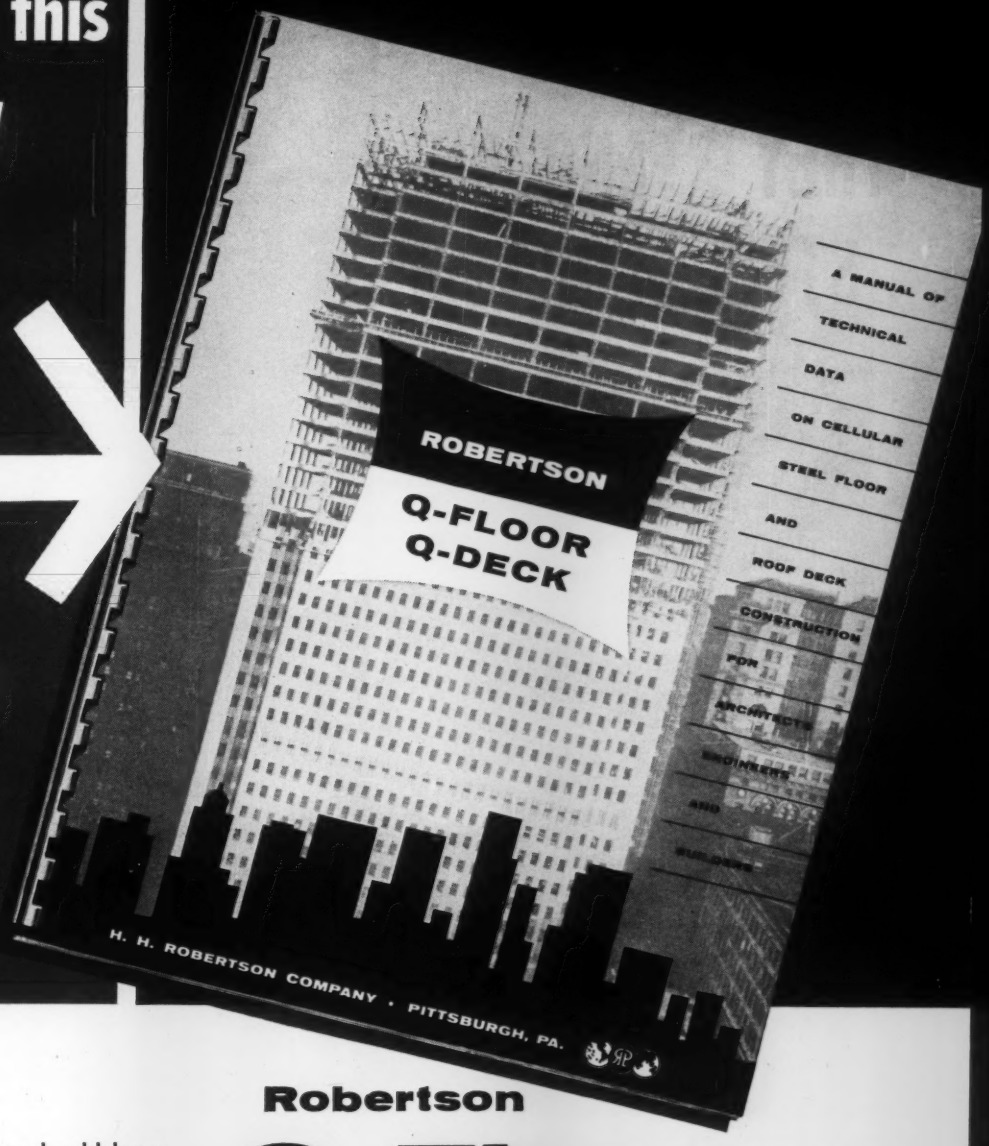
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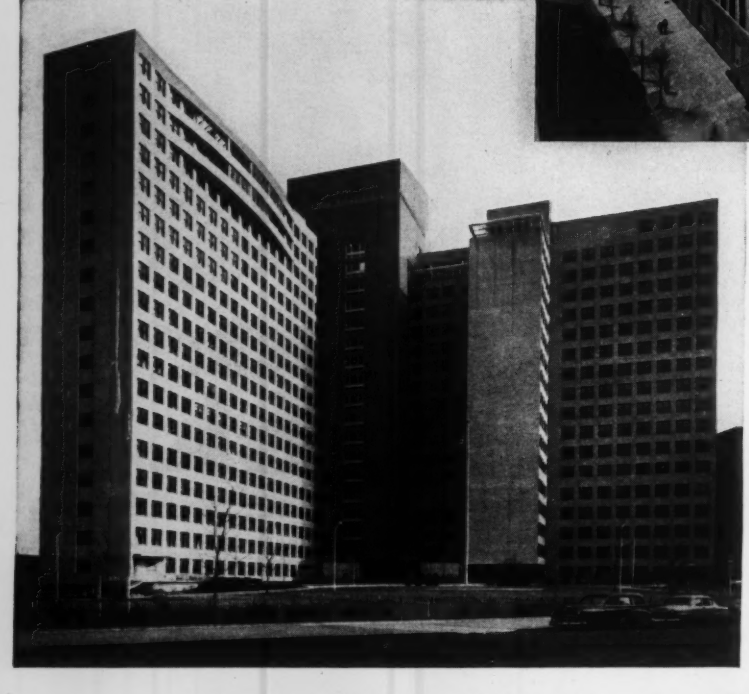

▲ John Hancock Building, Boston

The 26-story John Hancock Mutual Life Insurance Building in Boston rests on 1567 H-piles, varying from 88 to 120 ft in length and driven to bed rock. *Architects and Engineers:* Cram and Ferguson, Boston; *General Contractor:* Turner Construction Co., Boston and New York; *Piling Contractor:* Raymond Concrete Pile Co., Boston.

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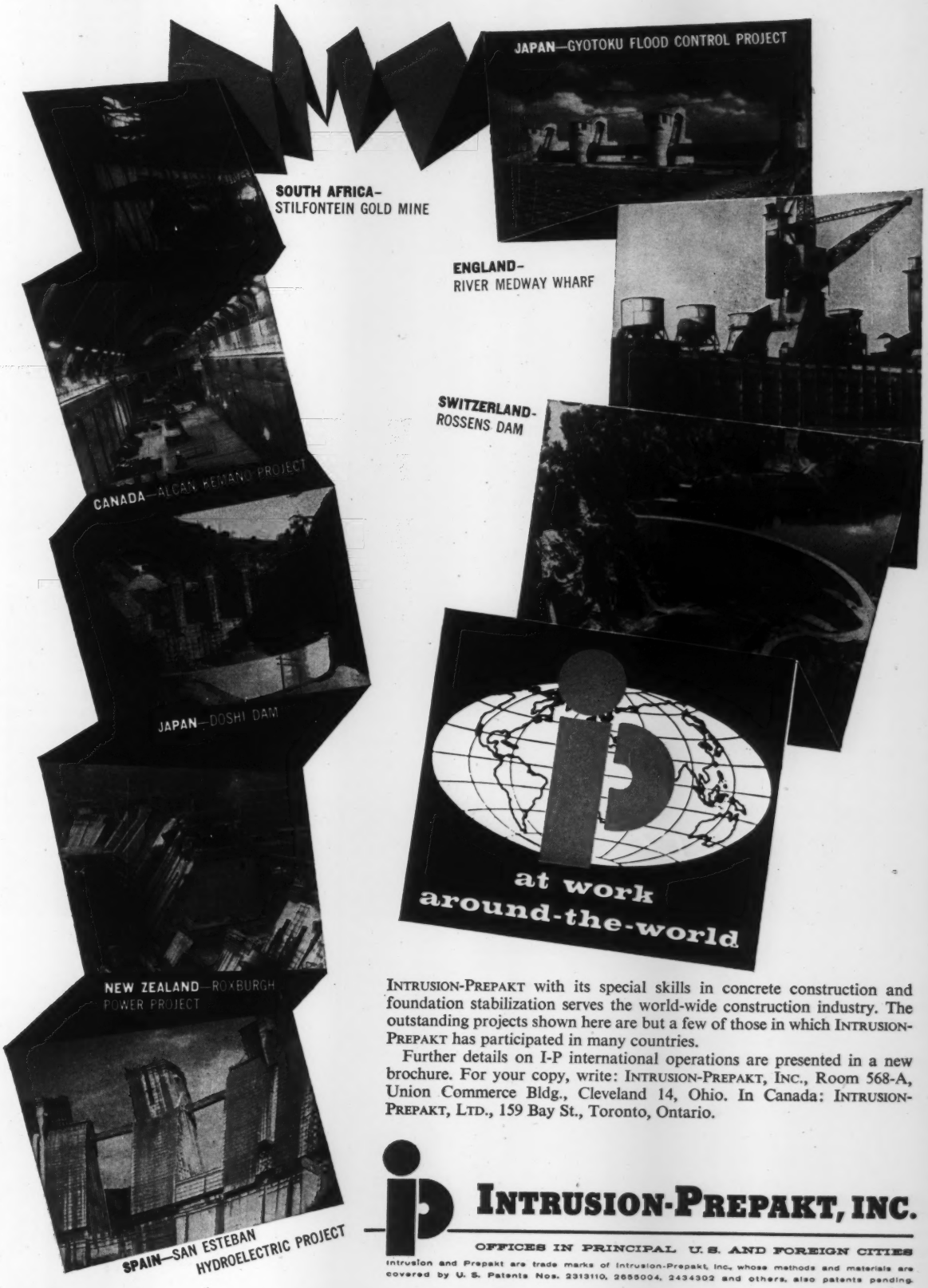
The 19-story Veterans Medical and Surgical Hospital in New York City rests on 2600 tons of steel H-piles. *Architects:* Alfred Hopkins and Associates; *General Contractor:* Cauldwell-Wingate Co., both of New York. *Piling Contractor:* I. B. Miller Contracting Co., Long Island City, N. Y.

BETHLEHEM STEEL

BETHLEHEM STEEL



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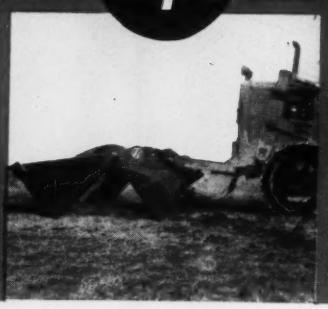
It's a 3-yd. Skid-Shovel...

with Drott's exclusive "concrete-shattering" triple-power pry-over-shoe break-out action—and 42° ground level bucket roll-back. Skid-Shovel position also gives you time-gaining, strain-saving load transport on the exclusive Skid-Shoes!

It's a 3-yd. Clamshell...



that "surrounds" loose materials and fills in one fast gulp. And the bottom-dumping clamshell gives you a 2½-foot dumping height advantage over ordinary roll-forward buckets—plus positive, clean-out action even when handling sticky materials!

"FLEET-BEATING PERFORMER"

"A new 3-yd. TD-18 4-In-1 Skid-Shovel proved able to do as much work as 3 power shovels and a dragline digging up and loading old concrete pavement on one of my recent highway jobs," reports Henry E. Berghuis, Prinsburg, Minn. "The 4-In-1 loaded up to 1,700 lineal feet of old pavement daily. Using 4-In-1 Clamshell bottom dumping, I also loaded out 4,500 yards of wet, sticky gumbo no other loader could tackle."

NOW.. big-scale four-machine utility!

It's a 3-yd. Bullclam . . .

that gives you regular "carry-type scraper" action to grade, strip or spread with inch-close accuracy, using clam lip control. *Plus* exclusive Drott Bullclam efficiency on all Sanitary Landfill operations including *positive fill compaction!*

It's a BIG -capacity Bulldozer

with clam lip up, and shoes on the ground, the blade rolls the earth with precision. You regulate dozing depth with ease and accuracy by hydraulic "radius control" of blade pitch (forward and backward).

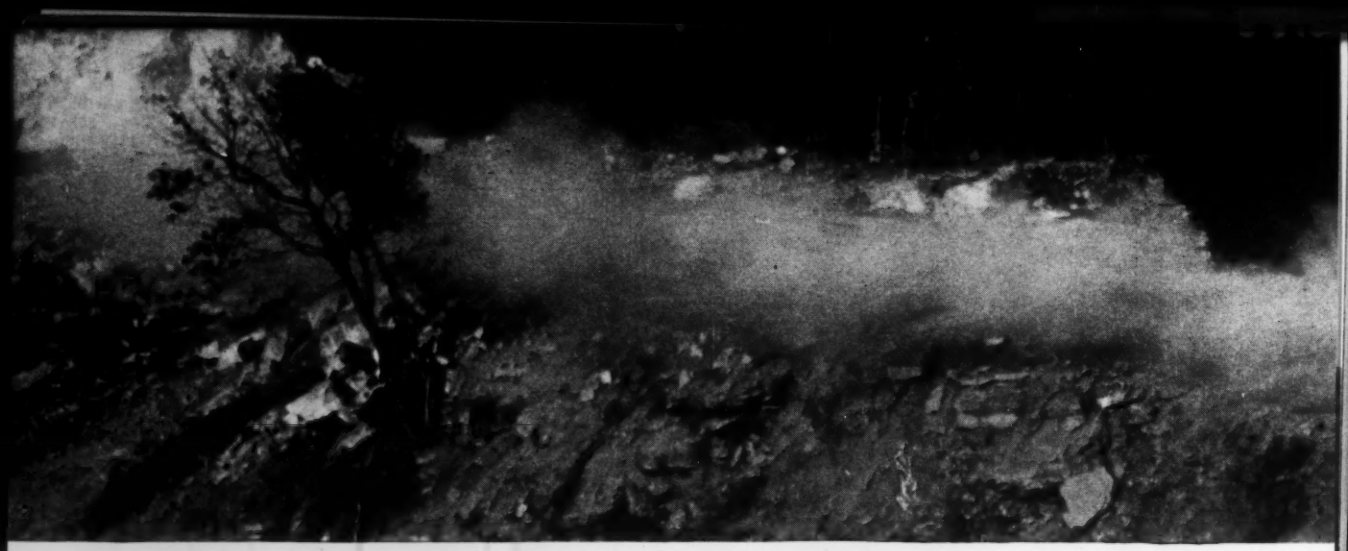
Touch the new 3-yard TD-18 Four-In-One's machine-selector lever! See how you instantly get any material-moving action you need—from the seat, with finger-tip ease—and stopped or on-the-go. Prove you can beat a fleet of limited-duty rigs with this *versatility unlimited*—get big-income, tough jobs other rigs can't handle! Compare the capacity-adding advantages of Drott exclusives like shock-swallowing Hydro-Spring and heap-keeping, parallelogram raise action. See your nearby International Drott distributor for a TD-18 Four-In-One demonstration. Or try the 1-yd. TD-6, 1½-yd. TD-9, or 2¼-yd. TD-14 Four-In-One!

International Harvester Company, Chicago 1, Illinois
Drott Manufacturing Corp., Milwaukee 15, Wisconsin

INTERNATIONAL HARVESTER

INTERNATIONAL®
DROTT®

See you at the
ROAD SHOW—CHICAGO
Jan. 28-Feb. 2, 1957



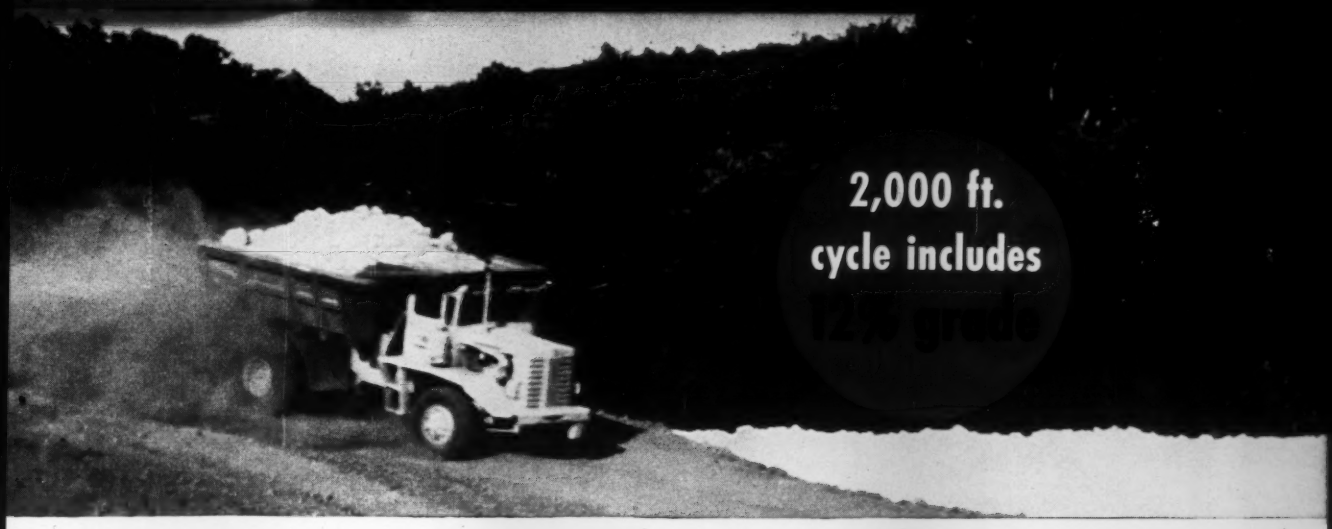
TWO LOAD-SPEEDING International® "95"

average 2400 cu. yds. of rock

TWO-TON CHUNKS OF LIMESTONE bang down into the huge Payhauler body—the rugged high-tensile steel sides, triple-section bottom, and super-duty "spring cushions" are built to take rock-shock! And the "95" Payhauler frame is strongest known of any off-highway truck in its class.

WITHOUT LOSING A SWING, 3 cu yd shovel always finds "95" waiting for load. Powerful, fuel-saving 335 hp Turbo-charged diesel engine keeps power high, reduces fuel consumption 10% or more. Maximum engine torque is transmitted efficiently through new cerametallic clutch and shock-saving planetary final drive into greater pay-off work power!

BODY UP... DOWN... IN ONLY 12 SECONDS! Three-stage, double-action hydraulic hoist provides full-time power control. Built-in hydraulic snubber valves assure smooth, over-center dumping action and gentles body return. Proper weight distribution permits safe dumping at edge of fill, yet drive wheels carry ample weight for steep-grade traction.



NO FOOT-BRAKING DOWN-GRADE! Heap-loaded "95" Payhauler rolls along safely down to the fill at 10 mph. Hand-operated Torqmatic brake, "torque converter in reverse," is standard equipment, gives accurate, confidence-building control at any speed...on any grade. Earl and Roy Schenewerk, operators of the "95's," say, "Because of Torqmatic brakes, these Payhaulers operate easier, smoother and safer than any other unit we've ever driven. Now, we have no worry on this steep grade."

Payhaulers®

per 10-hour day!

"Best Production I've ever had,"

Says H. D. BROWN
Project Superintendent,
Clarkson Construction Co.,
Kansas City, Mo.

High speed (up to 38 mph.), 16 cu yd capacity, and next-to-automatic operating control of two new International "95" payhaulers are getting Clarkson Construction Co. record-breaking rock production of 2400 cu yds per 10-hour day. Payhaulers are producing this outstanding yardage on the company's 1000-foot cut through dolomite limestone—part of their 7.5 mile, 2-lane highway contract between Bonne Terre, and Halifax, Mo.

The Payhaulers are operating on a 2000-foot cycle which includes a 12% grade. On this grade, too tricky and treacherous for Clarkson's other rock haulers, Payhaulers maneuver speedily and safely downgrade—under positive Torqmatic braking control! Payhaulers' high speed of up to 38 mph also permits the fast average round-trip travel time of only 2 min, 45 sec. That's faster than the 3 cu yd shovel can load one!

H. D. Brown, Project Superintendent, says, "The Payhaulers have got all other rock trucks beat. Control we've had with Payhaulers on this job is something we didn't have on any other truck. We've averaged 150 to 162 loads of 16 to 18 cu yds per 10-hour day. It's the best production I've ever had!"

Other veteran rock men who have used or seen the International "95" Payhauler in action say the same thing. You'll join them, too! Ask your nearby International construction equipment distributor to give you a demonstration.

INTERNATIONAL HARVESTER

INTERNATIONAL® Construction Equipment

International Harvester Company, 180 N. Michigan Avenue, Chicago 1, Illinois

A COMPLETE POWER PACKAGE INCLUDING: Crawler, Wheel, and Pipe-Beam Tractors . . . Self-Propelled Scrapers and Bottom-Dumps . . . Crawler and Rubber-Tired Loaders . . . Off-Highway Trucks . . . Diesel and Carbureted Engines . . . Marine Trucks

27-second loading.

deliver EXTRA "PAY-DIRT"

Note how extra-high Payscraper apron-lift provides *obstruction-free* room for fast unloading. And straight-line, *power-saving* ejector reeving leaves more power on Payscraper wheels, to speed dumping and spreading.

Air-assisted clutch; big, safe, 4-wheel air brakes; exclusive Hydro-Steer — all contribute to give the Payscraper its outstanding operating ease and safety. The two Payscrapers and two other towed scrapers are push-loaded by the TD-24.

Left to right: John L. Jersey; J. M. Harris, Supt.; Dale Jersey, Supt.; and William Donaco, General Supt. of the job.

. . . plus super-fast get-away . .

on industrial district job

for John L. Jersey, Inc., Portland, Oregon

John L. Jersey, Inc., Portland, Oregon, uses International "55" Payscraper loading and transport speed—and famous TD-24 *follow-through* push-loading—to highball the 833,000-cu-yd Rockwood Industrial District contract to timely, profitable completion.

In only 27 stop-watch-certified seconds, and only 60 to 100 feet of travel, each "55" Payscraper's bowl boils heaping full of gravelly soil—and the "55" is off to the fill at up to 20 mph!

"More dirt on the fill"—more dough in the till

Owner John L. Jersey reports: "Last year we put over 2,000 hours on both our '55' Payscrapers with cable replacements as the only necessary repairs. This year we got two more '55's' and a new TD-24 to load them fast. I believe '55's' are the most scraper for the money.

"We've found our '55's' load in 25-30 seconds. They're simple and easy to maintain and operate. Quick, full-load Payscraper get-away means more dirt on the fill, and that's what we get paid for."

Largest of its kind in the Pacific Northwest, the triple-terraced, 188-acre Rockwood project, on the Columbia river, is a Union Pacific Railroad Co. development—to attract new industry to the Portland area.

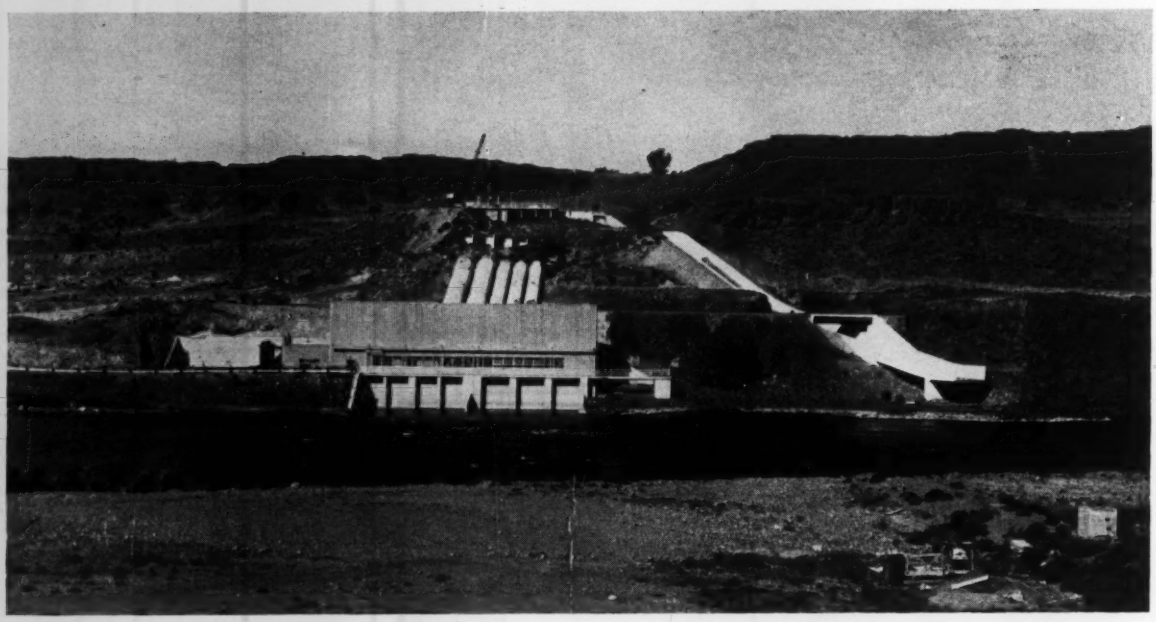
Prove to yourself no other rubber-tired dirt-mover gives you the new Payscraper combination of capacity-adding performance features! See your International Construction Equipment Distributor for a demonstration!

See you at the ROAD SHOW—CHICAGO—Jan. 27 to Feb. 4, 1957

INTERNATIONAL HARVESTER

INTERNATIONAL®
Construction Equipment

At the Bureau of Reclamation's Chandler Power & Pumping Plant, Leffel turbines drive both power and pumping units



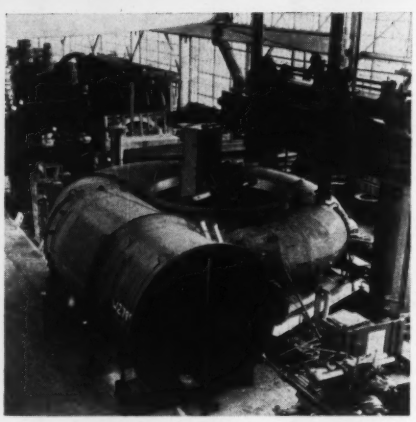
Chandler Power and Pumping Plant seen from the south side of Yakima River.

A principal component of the United States Bureau of Reclamation's Kennewick Division of the Yakima project, the Chandler Power and Pumping Plant is situated near the junction of the Yakima, Snake and Columbia Rivers in south-central Washington.

For economy in construction and efficiency of operation the power and pumping units were combined into one structure. Two Leffel turbines each rated at 8,500 HP under 118 feet net head, speed 240 RPM, drive the generators and two Leffel turbines each rated at 2,600 HP under 118 feet net head, speed 450 RPM, drive the pumps. These turbines are all of the vertical shaft, spiral case Francis type.

When you consider turbines for your power project—whether it is a new installation or the expansion of existing facilities—keep in mind the advantages offered by Leffel . . . 94 years of experience, free engineering assistance, a large modern plant and thorough workmanship.

For a 12-page folder describing all phases of the Chandler Power and Pumping Plant in complete detail and other literature showing Leffel turbines for all hydraulic power requirements fill out and return the coupon below.



One of the spiral casings for the 8,500 HP turbines on Leffel's 24′ boring mill.

1098-E

THE JAMES LEFFEL & CO.

FOUNDED IN 1862

MORE EFFICIENT HYDRAULIC POWER FOR 94 YEARS

FREE LITERATURE

THE JAMES LEFFEL & COMPANY
DEPT. C SPRINGFIELD, OHIO

Please send me 12 page folder on Chandler Power and Pumping Plant and other descriptive literature on Leffel hydraulic turbines.

Name_____ Title_____

Company_____

Street_____ City_____ State_____

WHEN CONSTRUCTION JOBS CALL FOR SOIL COMPACTION

BARCO is the ANSWER!

THE KEY TO BETTER CONSTRUCTION—No recent trend in construction has had a more phenomenal growth than the specification of HIGH DEGREE SOIL COMPACTION for all kinds of projects—Atomic Energy, Hydroelectric Power and Flood Control Dams, Highways, Toll Roads and Freeways, Airports, Bridges, Buildings, and Housing Developments!

EASILY MEETS RIGID SPECIFICATIONS—In test after test, Barco Rammers have demonstrated their ability to deliver 95% to 97.5% compaction (modified Proctor Method)—EASILY! EFFICIENTLY! ECONOMICALLY! The Barco Rammer is especially useful for compacting fill in restricted areas. ONLY the Barco Rammer can produce specified high degree compaction on lifts up to 20 inches.

GETS JOBS FINISHED ON TIME—One of the biggest advantages offered by Barco Rammers is ability to handle work in minimum time. On area tamping, one man can average 20 to 30 cubic yards of fill per hour. On trench backfill, using lifts up to 24", the rate for 18" trench is 360 to 600 feet per hour. *When time is at a premium,* BARCO IS THE ANSWER—find out about it NOW!

For Soil Compaction Close to Walls, Culverts and Abutments —in Trenches, Ditches

BARCO *GASOLINE* RAMMER

BARCO MANUFACTURING CO.
561M Hough St., Barrington, Illinois

Gentlemen:
YES! I want to know about Barco Rammers for Soil Compaction:

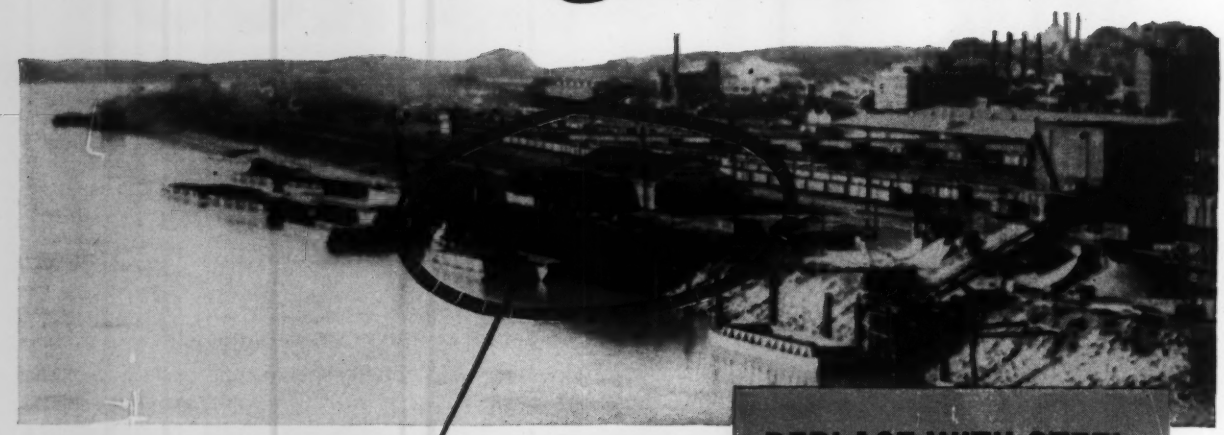
Name_____

Street_____

City_____

☐ Please send General Catalog No. 621.

This busy old St. Louis dock given new life with



REPLACE WITH STEEL

once and for all!

Time and weather beaten, the old dock above with its wooden piling, at left, cost the owners a pretty penny in maintenance until replaced with long-lasting, *trouble-free* USS Steel H-Beam Bearing Piles, as shown at the right. If you have a similar upkeep problem, why not consider the advisability of modernizing your piers and docks with these more permanent steel piles.

On large jobs and small—under piers, docks, buildings, bridges and viaducts, these strong, easily driven H-Beam Piles have proved their ability to provide a secure means of carrying foundation loads into stable mediums lying at great depth. Their capacity for high unit loads, both vertical and horizontal, permits fewer driving operations for a given load. USS Steel H-Beam Bearing Piles are easy to splice, eliminate jetting, and withstand rough handling.

BELOW: The old wooden floor of the dock was replaced with serviceable USS Multigrip Steel Floor Plates.

USS Steel H-Bearing Piles

Mississippi Valley Barge Line figures new steel foundation for this important pier will pay for itself in about 20 years!

Time, weather, and the erosive waters of the turbulent Mississippi made maintenance of this important old St. Louis pier a costly proposition. Frequent repairs interfered with the profitable operation of this normally busy, and often crowded, dock.

Finally fed up with such periodic inconveniences, its owners, the Mississippi Valley Barge Line Company, decided to replace the original wooden piles supporting the 195'6" x 40' dock with steel bearing piles. They figured that the permanence of steel would prove more economical than wood when pro-rated over a 20-year period.

The modernization job was done by Massman Construction Company, Kansas City, Missouri, who chose USS Steel H-Bearing Piles for the heavy-duty foundation. One hundred and sixteen tons of CBP-124 (12"—53#) steel H-piling in lengths of 60' and 70' were used to support the rebuilt dock. The new steel piles were driven to refusal at a depth of about 35' into coarse sand and gravel.

The company also replaced the old timber flooring with USS Multigrip Steel Floor Plate. The resulting improvement is a sturdier, longer-lasting dock—one that will more than pay for itself in the practically maintenance-free service it gives.

SEE THE UNITED STATES STEEL HOUR. It's a full-hour TV program presented every other week by United States Steel. Consult your local newspaper for time and station.

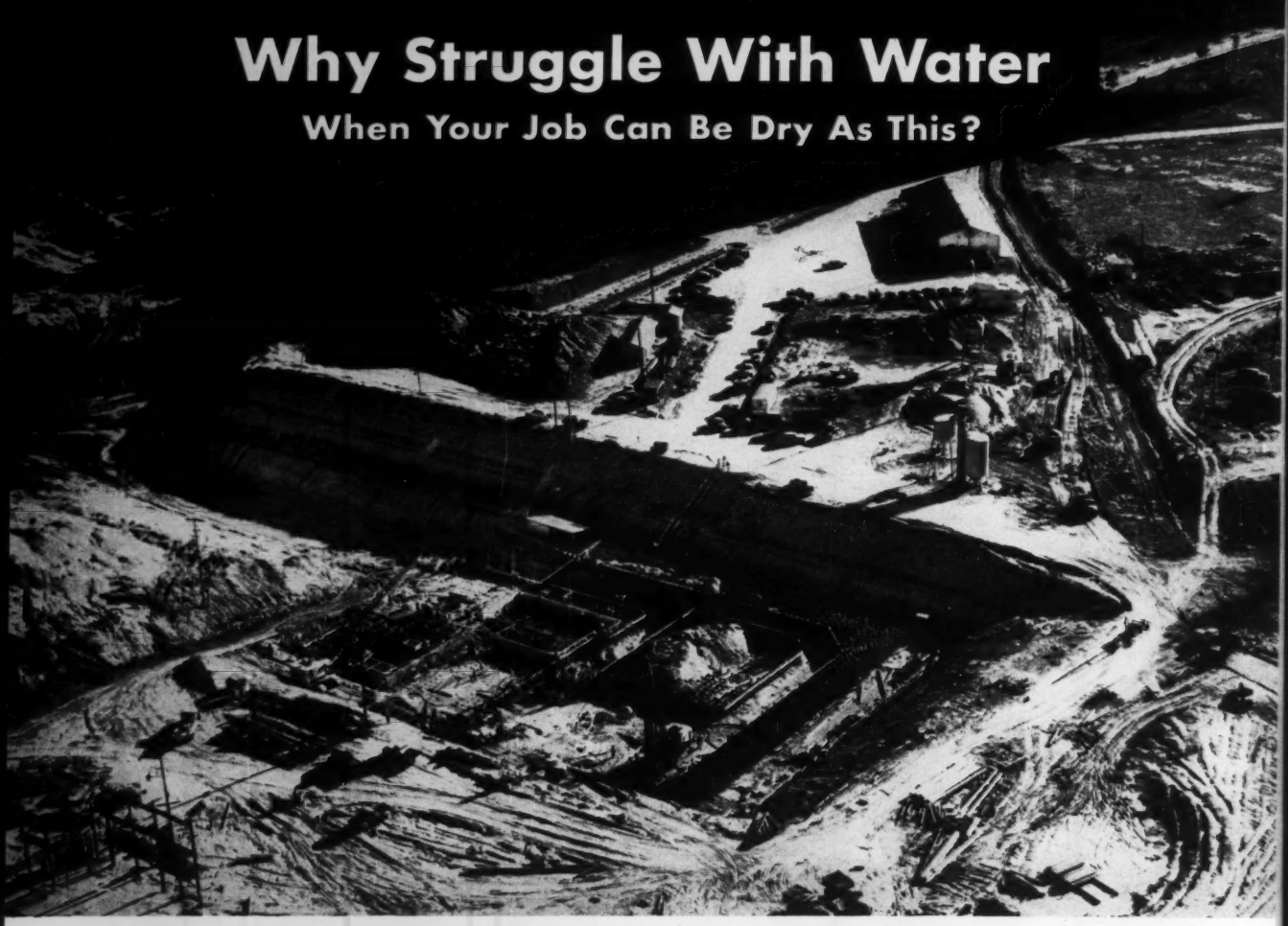
UNITED STATES STEEL CORPORATION, PITTSBURGH • COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO
TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA. • UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS Steel H-Bearing Piles USS

UNITED STATES STEEL

Why Struggle With Water

When Your Job Can Be Dry As This?



Pumping Contractors: American Dewatering Corp., New York, Houston, Texas

The economic importance of getting a wet job off to a good dry start is thoroughly understood by Mississippi Power Co., Gulfport, Miss. Faced with the problem of handling 23' of water in clay, sand and silt on this deep power plant foundation, they lost no time in installing a dependable MORETRENCH WELLPOINT SYSTEM which:

1. **Immediately gave them a workable dry job.**
2. **Permitted excavation and related work to proceed according to schedule without interruption — in perfect safety.**

A good start on any project is half the battle. *On a wet one, it's a necessity!* That's why successful contractors pump with MORETRENCH.

For full information, contact our nearest office.
Rentals, sales, contracts.

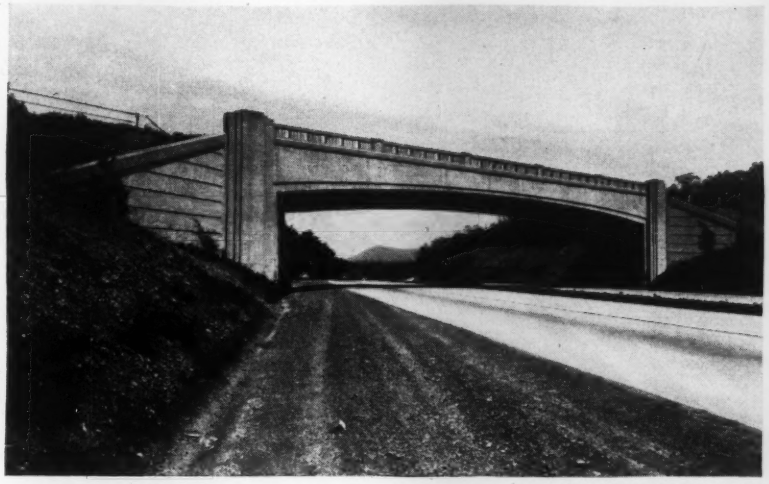
MORETRENCH CORPORATION

90 West St, New York 6 | 4900 S. Austin Ave., Chicago 38, Illinois | 7701 Interbay Blvd., Tampa 9, Florida | 315 W. 25th St., Houston 8, Texas | Rockaway, New Jersey

Western Representative: Andrews Machinery of Washington, Inc., Seattle 4, Washington

Canadian Representative: Geo W CROTHERS Limited, Toronto, Ontario

Brazilian Representative: Oscar Taves & Co., Ltd., Rio de Janeiro



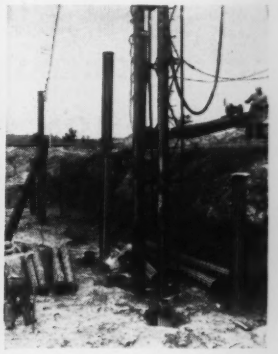
PENNSYLVANIA TURNPIKE

DELAWARE EXTENSION TO PENNSYLVANIA TURNPIKE

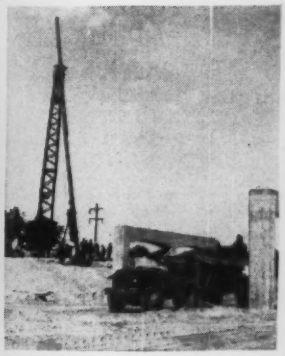
Monotube Piles FOR TURNPIKE AND THRUWAY CONSTRUCTION...WHERE SPEED AND ECONOMY COUNT

OHIO TURNPIKE

TURNER TURNPIKE, OKLAHOMA



NEW YORK THRUWAY



NEW JERSEY TURNPIKE

TAPERED and fluted Monotube piles—used in turnpike construction since the inception of such projects—offer *big* advantages that mean *big* savings.

Monotubes save time and money because of simplified on-the-job weld splicing, easy extendibility, quick cut-offs and minimum waste. Light mobile driving equipment is all that's required to drive lightweight Monotubes quickly and easily to any required depth.

Monotubes, cold-rolled for added strength, are recognized for their exceptional load bearing capacity. This, plus top-to-bottom visual inspection before concreting, means heavier loads with fewer piles. Also, with Monotubes there's a choice of gauge, taper, diameter or length . . . for varying soil conditions.

Before starting that next foundation job, find out how you can save with Monotube piles . . . without sacrificing strength or sound construction. Write today to The Union Metal Manufacturing Company, Canton 5, Ohio, for Catalog No. 81.

UNION METAL

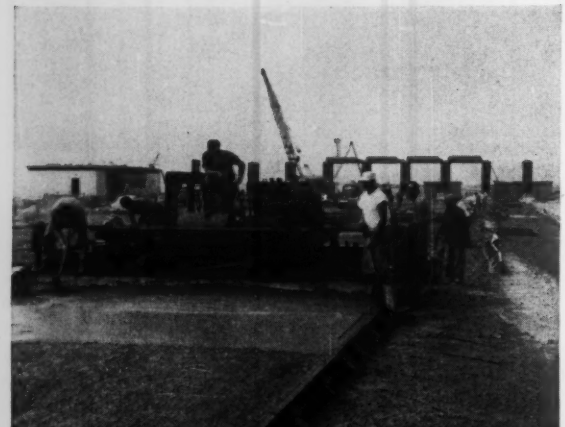
Monotube Foundation Piles

This network of ramps, takeoffs and highway composes the three mile stretch of New Jersey Turnpike extension worked by Geo. M. Brewster & Son, Inc.

"Flex-plane

.....makes the

REMARKABLE SELF-WIDENING FINISHER MAKES SMOOTH WORK OF COMPLEX HOLLAND TUNNEL EXTENSION OF JERSEY PIKE!



Flex-Plane's Triple Lap Frame provides unsurpassed steadiness even at its widest width. Here machine works 23' slab in extended position.

"There's only one machine that could have done this job," states Byron Craig, Paving Superintendent of Geo. M. Brewster & Son, Inc., "and that is Flex-Plane's Self Widening Finisher."

The job Byron Craig was talking about is the Newark Bay-Hudson County Extension of the New Jersey Turnpike, a three mile stretch of ramps, turnoffs, interchange lanes and service area cutoffs that connects the busy toll road with the Holland Tunnel.

"This job was a real challenge," continues Craig, "A typical pour would range from 4′ to 14½′ to 19′, back to 15′ - 8″, then up again to 23′. The Flex-Plane Self Widener worked these variable width slabs as easily as though it were a straight pour. What's more I find Flex-Plane builds a 'paving man's' machine. It's strong and sturdy at its widest width, and it comes in a width selection that makes sense."

You'll find most leading paving firms own Flex-Plane finishers. It's the most popular finishing machine ever built. If you are in the market for finishing equipment let us put you in touch with a contractor in your area who'll convince you there's absolutely nothing to match it.

THE FLEXIBLE ROAD JOINT MACHINE CO.

9002 THOMAS ROAD, WARREN, OHIO

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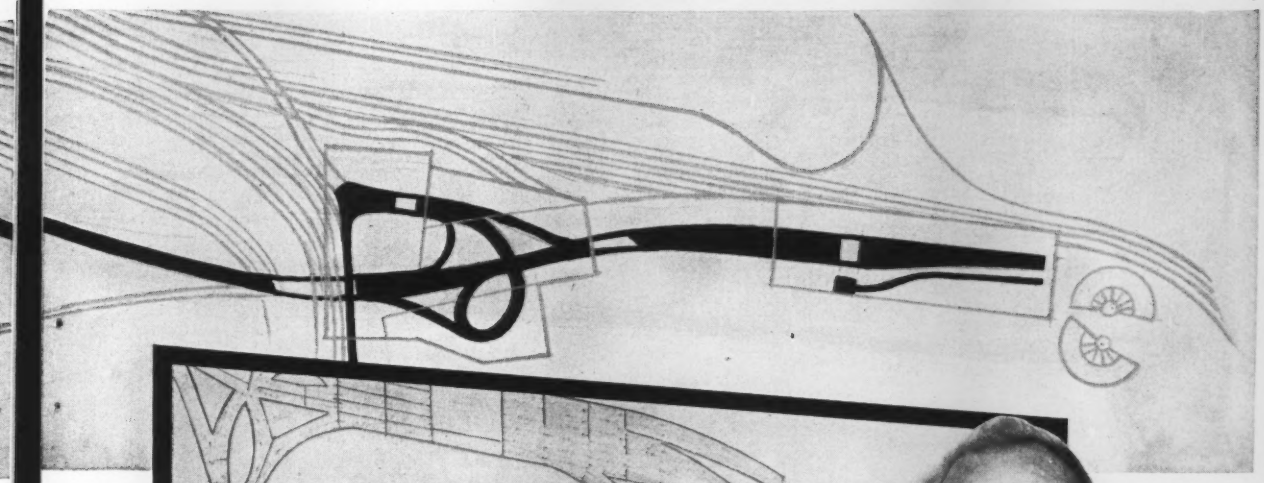
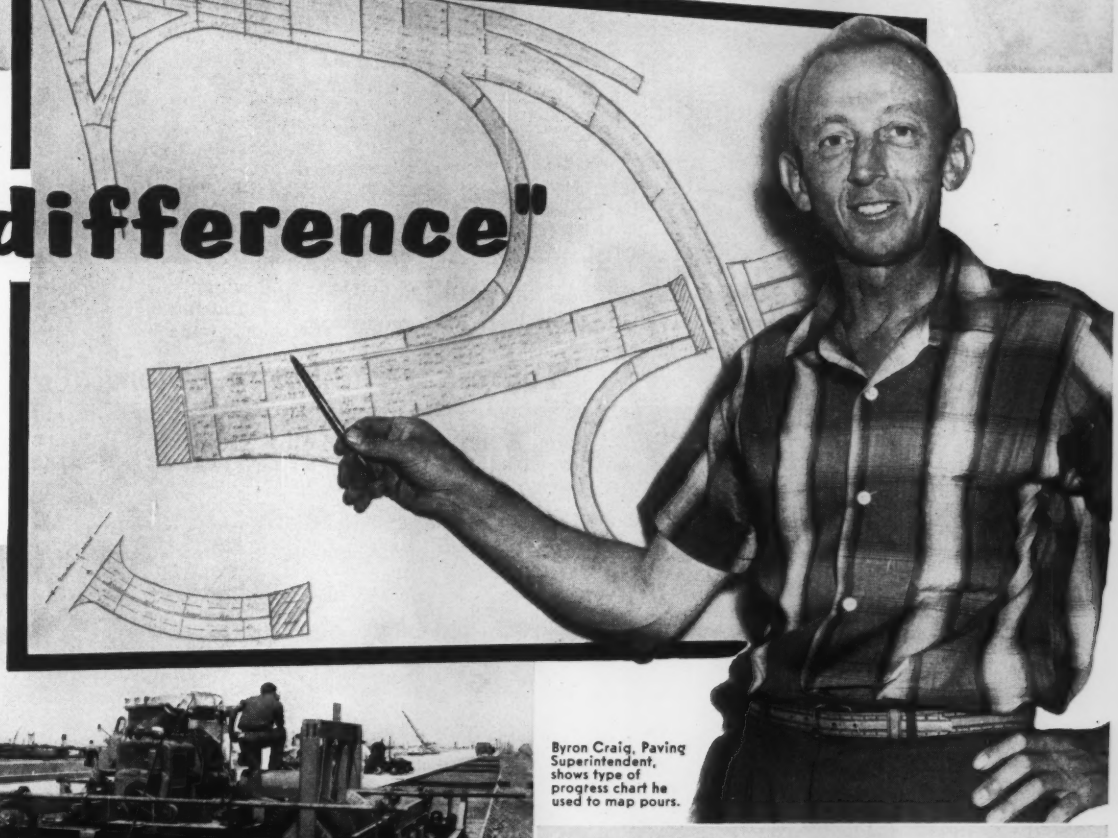
WORLD'S LARGEST MANUFACTURERS OF CONCRETE FINISHING EQUIPMENT



difference"



Byron Craig, Paving Superintendent, shows type of progress chart he used to map pours.

▲ Typical slab section. Note unusual tapering. Brewster was able to maintain above average pour with a single Flex-Plane machine without a spreader.

Here machine works narrow take off strip in contracted position. Three mile stretch had 10 such strips plus 8 ramps and one underpass. ▶

Pike's Peak overlooks east side of Ute Pass in Colorado.
Motorists travel highway safely, securely on asphalt.

Tourist attraction in Colorado—

Good Roads with STANDARD Asphalt

Motorists want good roads. They like to drive on asphalt. Contractors building roads in Mid-America benefit by specifying STANDARD Asphalt. Here's why:

1 Assured source of supply. Standard Oil has a demonstrated record of deliveries on contract. Contractors know that when they order from Standard, they have an assured source of supply.

2 Convenient source of supply. Tank car and tank truck deliveries are made from five conveniently located Standard Oil refineries.

Wood River, Illinois — Casper, Wyoming
Whiting, Indiana — Neodesha, Kansas
Sugar Creek, Missouri

3 Complete line. Standard Oil makes a full line of paving asphalts. They meet most rigid requirements.

4 Experienced asphalt sales specialists. Standard Oil men who sell asphalt know road construction, know what a contractor's needs and problems are. They know how and what to do to give a builder service on asphalt.

Get more information about the advantages of ordering STANDARD Asphalt. Call any of the 23 Standard Oil offices in the 15 Midwest or Rocky Mountain states. Or write Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

STANDARD OIL COMPANY
(Indiana)

STANDARD

For Houston's new 50 mgd plant . . .

Freese, Nichols & Turner, Consulting Engineers, specified the most modern, master filter control system.

This system, for the City of Houston's recently completed $5,000,000 modern water purification plant that is now in service, must deliver top filter performance: maintain exact total flow despite changes in head in 8 filters; precisely measure flow rate, head loss; carefully control wash rates to protect beds; transmit all vital data to *one central control point*—with no lag, no hunting, no inaccuracies.

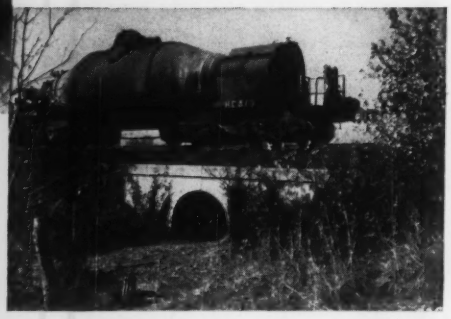
To meet these rigid requirements, Simplex flow controllers and instrumentation were selected. For dependable pipe-gallery operation, Simplex Laminair® units *pneumatically* transmit data to operating tables. For complete control of all the wide spread operating elements, Simplex Orthoflow® units *electrically* transmit data to one central point—instantly, accurately.

Your plant may achieve automated operation with minimum changes in present instruments and controls. Write for information. Simplex Valve & Meter Company, Dept. CV-11, 7 E. Orange Street, Lancaster, Pa.

SIMPLEX®
VALVE AND METER COMPANY

This Armco Sewer has served nearly a half-century and has a life expectancy of many more years.

For long life
Armco Sewer Structures give you both structural and material durability



The 346-ton wheel load of this ladle car has traveled over this 6-foot-diameter Armco Corrugated Metal Pipe several times daily for 29 years.

Armco Corrugated Metal Structures combine both material and structural durability for balanced design. Any sewer structure needs both of these durability features. One without the other is useless. If the sewer fails structurally, your investment is lost no matter how long the material lasts.

Armco corrugated metal construction features high strength with light weight. Bolted connector bands assure strong, tight joints.

With Armco Structures you can save money by specifying the degree of material durability you need for each condition. Plain galvanized Armco Pipe and Pipe-Arch are ideal for normal service. Armco ASBESTOS-BONDED combats severe corrosive conditions. PAVED-INVERT withstands highly erosive flows. And for lasting top flow capacity, you can specify Armco SMOOTH-FLO Sewer Pipe.

Write for data applied to your specific sewer or drainage projects. Armco Drainage & Metal Products, Inc., 4736 Curtis Street, Middletown, Ohio. Subsidiary of Armco Steel Corporation. In Canada: write Guelph, Ontario. Export: The Armco International Corporation.

ARMCO

ARMCO
Sewer Structures

Installation of these two 5′-high SMS Bascule Gates on a dam 28′ in height will enable the City of Decatur, Illinois, to more than double its present water storage capacity, even in dry years. The training wall and concrete pier between the gates is designed to minimize downstream cross-flow and damage to the apron. Harza Engineering Co., Chicago, Illinois, Consulting Engineers.

Individual 29′-long sections of the gate are installed in graphited bronze bearing shoes. A Bascule Gate was chosen over other types here when engineering studies proved it most economical and simplest.

View from downstream side shows final connection of one of the several hydraulic operating cylinders for each gate. Piping on the face of the dam immediately below provides individual isolation of any cylinder.

One of the two 500 psi oil accumulator tanks is about to be raised into position at the control station. Pumps supply pressure to the accumulator tanks for emergency operation in the event of power failure.

New SMS Bascule Gate Design Provides a CLEAR CREST, UNLIMITED LENGTH

Now SMS Bascule Gates can be built to any length you need, and installed without intermediate piers or overhead structures. With this new SMS design, hydraulic operators are located under the gate leaves and controlled from either end. The installation shown above consists of two 233′9″ gates. They are the longest ever installed.

An SMS Bascule Gate will increase the storage and spillway capacity of existing dams quickly and economically. It enables you to control heavy run-offs without losing stored water, and to handle regional hazards like ice and heavy debris. In its open position, the gate lies flat on the dam crest and presents no obstruction to flow.

For full information on this new SMS Bascule Gate design—or on hydraulic turbines and other accessories—write to S. Morgan Smith Co., York, Penna.

S. MORGAN SMITH

AFFILIATE: S. MORGAN SMITH, CANADA, LIMITED, TORONTO

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Apartment Building, Pittsburgh, Pa.
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Contractor: Larson Construction Company,
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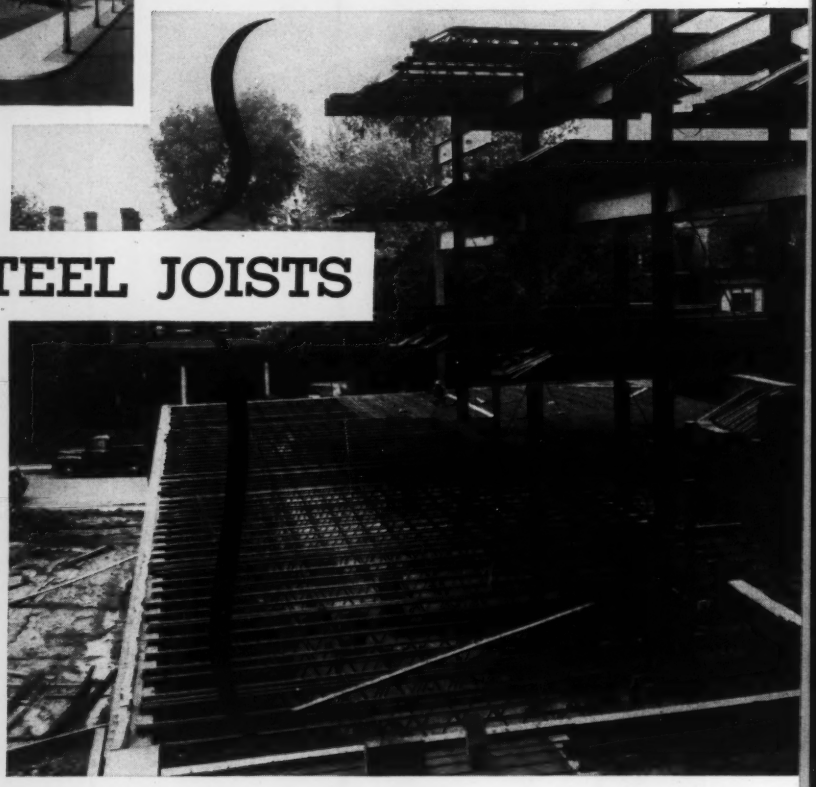
Structural steel and standard steel joists by American Bridge



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The handsome new apartment building shown in the rendering above is another good example of steel-frame construction in combination with AmBridge Standard Steel Joists for all floor and roof supports.

Fabricated and erected by American Bridge for this strong, fireproof structure were 710 tons of structural steel and 809 tons of AmBridge Standard Steel Joists with accessories.

USS AmBridge Standard Steel Joists provide rigid, lightweight and economical construction suitable for any type of floor, roof and ceiling. The underslung and open-web design provides for maximum headroom and allows passage of pipes, ducts and conduits in any direction.

In floor construction, the ease and simplicity of handling this new-design steel joist reduce installation time to a minimum and permit other trades to begin work promptly. And for roof construction, it cuts the time required to put your structure under cover.

Fabricated and assembled on a modern production line basis to assure you a better product in faster time, USS Ambridge Steel Joists will enable you to build an economical structure without interruption of your schedule. For detailed information about the time- and money-saving advantages of these superior products on your next job, get in touch with our nearest office.

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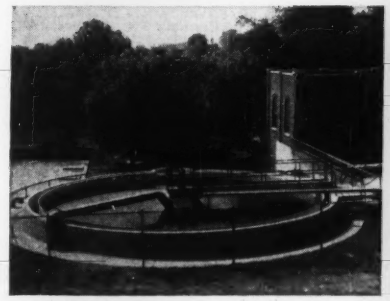
AMBRIDGE STEEL JOISTS

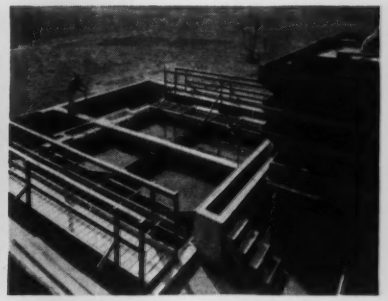
USS

UNITED STATES STEEL



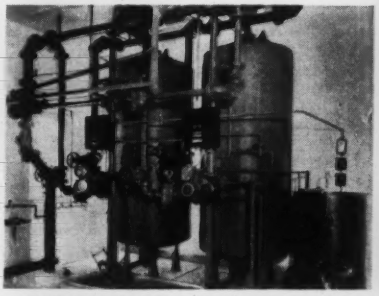
TURBIDITY gets cut from 1500 to less than 5 ppm in this Precipitator. Mt. Carmel, Ill. Cons. Eng.: *Warren & Van Praag, Inc.*

SEA WATER saves $32,980 per year over salt for regenerating Softeners. Hollywood, Fla. Cons. Eng.: *Reynolds, Smith & Hills.*

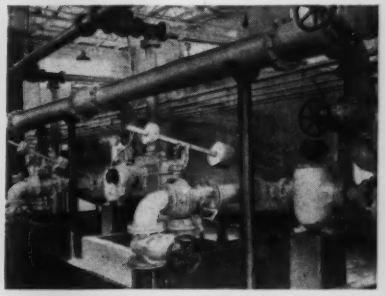


30 PPM IRON gets cut to 0.14 ppm in Aerator and Precipitator . . . even before filtration! Fairless Hills, Pa. Cons. Eng.: *H. H. Le Van, Jr.*

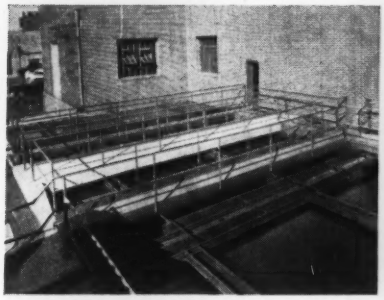
HARDNESS TESTER starts regeneration of softeners automatically, saves manpower. E. Aurora, N. Y. Village Eng.: *E. J. Maurer.*



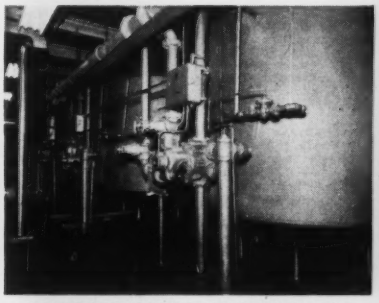
269 PPM HARDNESS is removed by these automatic Softeners. Aerator and Filters cut iron. Martinsville, Ill. Supt.: *O. Wiser.*



AUTOMATIC CONTROLS backwash, regenerate, rinse and return Softeners to service. New Smyrna Beach, Fla. Cons. Eng.: *Russell & Axon.*



OLD SETTLING BASINS house these modern Precipitators that boost capacity. North Kansas City, Mo. Cons. Eng.: *C. A. Haskins.*



SOFTENER CAPACITY TRIPLED and $7,000 yearly saved on salt by change to Permutit Q resin. Normal, Ill. Cons. Eng.: *Farnsworth & Conley.*

TRIPLE TROUBLE! 275 ppm hardness, 200 ppm alkalinity, 3 ppm iron are reduced by this Precipitator. Staples, Minn. Supt.: *E. H. Klang.*

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Men Available

PROJECT ENGINEER OR GENERAL SUPERINTENDENT, A.M. ASCE; B.S.C.E.; 35; general superintendent and/or project engineer, industrial and commercial building construction as well as heavy construction for 10 years. Material take-off and estimation. Registered professional engineer. Location desired, South, West or overseas. C-164.

ASSOCIATE PROFESSOR, civil engineering or mechanics; J. M. ASCE; M.S., Ph.D.; 37; 6 years' as field engineer in railroads, 2 years' as field designer (highway and railway bridges), 3 years' assistant professor in civil engineering and mechanics. Location desired, anywhere but South. C-165.

INSTRUCTOR OR ASSISTANT PROFESSOR, A. M. ASCE; B.S. in C.E.; 50; graduate assistant at U of Washington for one quarter, 1935; instructor to assistant professor at U of Alaska, 1938 to 1942; taught several surveying courses, descriptive geometry, elementary structures, remedial mathematics. Location desired, Pacific Coast. C-166.

CHIEF ENGINEER, J.M. ASCE; B.S.C.E.; 28; total 8 years' experience; includes 5 years direction of engineering and construction design groups; planning, design, working drawings, industrial structures maintenance and public works. Executive ability. Location desired, East or South. C-167.

CONSTRUCTION EXECUTIVE, M. ASCE; B.S. in C.E.; 47; 26 years' experience with contractors in all phases of industrial and commercial construction. Location desired, East. C-168.

Positions Available

SUPERINTENDENT for construction and maintenance department, registered engineer with considerable U. S. construction experience, capable of supervising all major construction, repairs and maintenance of housing and commercial structures. Salary, $12,000 a year. Location, Chile. F-3855.

RESIDENT ENGINEERS, civil or mechanical graduates, with at least 6 years' field engineering and supervisory construction experience covering manufacturing plants, industrial and commercial buildings, for field supervision of large construction projects as owner's representative in responsible charge. Salary, $7,500–$10,000 a year. Various locations of projects as components of a continuing nation-wide program of plant expansion. W-3865.

ASSISTANT PROFESSOR OR INSTRUCTOR to teach Sanitary and other civil engineering subjects. M.S. preferred but B.S. considered. Immediate appointment available. Salary, dependent upon qualifications, to $6,000. Location, Midwest. W-3899.

CHIEF DESIGN ENGINEER, civil or structural graduate, 40–55, for review and approval of designs and drawings for large continuing nationwide building program. Minimum of 15 years' progressive experience with large consulting engineering firm on manufacturing plants and commercial buildings with responsible charge as project engineer, including coordination of mechanical and electrical engineering. Salary, $13,000–$16,000 a year. Location, upper New York State. W-3932.

ASSISTANT DISTRICT SUPERINTENDENT, civil graduate, preferably with P.E. license and at least 5 years' industrial and commercial building construction, equipment installation and maintenance experience. Salary, $6,000–$7,000 a year. Location, New York, N. Y. W-3936.

DISTRICT MANAGER with civil engineering training, estimating and sales experience in the building and heavy construction fields, to sell fabricated plant and reinforced concrete products. Salary, $6,000–$8,000 a year, plus bonus. Location, New York, N. Y. W-3950.

DESIGNERS, civil graduates, with 10 to 15 years' experience in the design of airfields, roads, etc. Work will include design of pavements, grading plans and drainage structures, etc. Salary, $8,320 a year. Location, Virginia. W-3953.

STRUCTURAL ENGINEER qualified by training and experience to design the wood, concrete and steel structural portions of buildings. Salaries open. Location, Virginia. W-3955(*c*).

ENGINEERS. (*a*) Administrative Engineer thoroughly experienced in cost accounting, material procurement and expediting, general office procedure, personnel relations. Building and heavy construction. Spanish language ability and Latin American experience highly desirable. Salary open. (*b*) Building Construction Superintendent or Project Manager, thoroughly experienced and capable of supervising all aspects of the construction of large high type buildings. Spanish language ability and Latin American experience highly desirable. Salary open. Location, South America. F-3982.

CIVIL ENGINEER, graduate, with experience in road and drainage construction. Salary commensurate with ability. Permanent. Location, Louisiana. W-3989.

ASSISTANT TO CHIEF ENGINEER, civil graduate, with N. Y. State P. E. license and at least 6 years' experience in engineering surveys, tests, specifications, and reports covering highways, buildings, materials, equipment and controls. Salary, $7,100 a year. Location, New York, N. Y. W-4006.

CIVIL OR STRUCTURAL DESIGNER to assume responsibility for structural steel and reinforced concrete design. Must be willing to work on the board in connection with projects assigned to him. Salary open. Location, northern New Jersey. W-4017(*a*).

ENGINEERING ADMINISTRATIVE ASSISTANT with civil or architectural engineering training and at least 3 years' design, specification and office engineering experience covering industrial building construction for architectural firm. Salary, $6,000–$7,000 a year. Location, New York, N. Y. W-4060.

ENGINEER-EDITOR, young, graduate civil or electrical, out of school 2 or 3 years, with at least one year's experience in a consulting engineer's office, to prepare articles based on interviews with consulting engineers, etc. Salary, $6,000 a year. Location, New York, N. Y. W-4064.

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Immediate openings in Olympia for graduate civil engineers with or without experience to design and check the design of simple and indeterminate reinforced concrete and steel structures. Considerable hydraulic work on occasion. Good opportunity for advancement. Progressive, non-political merit system. Minimum of 12 working days each of vacation and sick leave per year. Retirement system. Five step automatic wage increase schedule. $432 per month minimum starting salary. No overtime required. Write for application blank to William T. Read, Personnel Officer, Washington State Highway Department, Transportation Building, Olympia, Washington.

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GENERAL MANAGER, civil graduate, with at least 10 years' construction management experience covering responsibility for general supervision of sales, estimates, sub-contracts, and field supervision of public works, pipelines, excavations and general concrete construction. Must be Mexican citizen. Salary, $15,000–$20,000 a year, plus bonus. Location, Mexico. W-4076.

POLLUTION ABATEMENT ENGINEER, degree in chemical engineering, or civil engineering with major in sanitary engineering, with a minimum of 5 years' experience in field of chemical pollution abatement. Would involve experience in design of industrial plant facilities to process wastes from chemical operations as well as knowledge of sanitary disposal facilities. Should be familiar with State and Federal regulations on air and stream pollution. Will perform the engineering or supervise the engineering to design and specify installations for waste disposal as needed for new or existing operations, etc. Salary open. Some travel. Headquarters, Missouri. W-4079.

ASSISTANT CHIEF ENGINEER, graduate civil, either a recent graduate, or one with a few years' experience, for structural design of steel buildings and the development of a research program. Salary, from $5,400 a year, depending upon experience. Location, California. W-4101.

CIVIL ENGINEERS, junior and senior, civil graduates, with experience in design and construction of large water supply projects. Salaries, $4,800–$8,400 a year. Location, California. W-4102.

ENGINEERS. (*a*) Structural Engineer with 10 years' experience, 5 of which have been in hydroelectric projects. Single status desired but will take married man. Salary, $12,000 a year, plus living allowance. (*b*) Layout Engineer for field work on above projects. Salary, $10,800 a year, plus living allowance. Location, Mediterranean area. F-4103.

FIELD ENGINEER, civil graduate, with at least 3 years' heavy construction experience, including pile driving for marine pier terminal project. Salary, $10,000 a year. Duration, 1 year. Location, South America. F-4104.

CONSTRUCTION SUPERINTENDENT, under 55, civil or mechanical graduate, with at least 10 years' supervisory construction experience covering power plants, mill buildings, roads and utilities. Salary, $10,000 a year, plus extras. Location, Cuba. F-4117.

LABOR RELATIONS MANAGER, staff position, for large construction company. Must have experience in labor contracts, jurisdictional disputes, etc. Considerable travel. Salary, $10,000–$12,000 a year. Company will pay fee. Headquarters, Ohio. W-4121.

TEACHING PERSONNEL, master's degree in civil engineering preferred, but will consider bachelor's degree in civil, with or without experience. (*a*) One needed to teach statics, dynamics, strength of materials, hydraulics and surveying. (*b*) One to assist in courses in structures and reinforced concrete theory. Salaries, $4,200–$5,400 for nine months. Positions available in February, 1957. Location, Southwest. W-4128.

WATER SUPPLY DESIGN ENGINEER with sufficient experience and responsibility to assume charge of the design of filtration pumping plants, pipe lines and incidental structures. Preferably licensed in New York State. Salary open. Location, New York, N. Y. W-4133.

DESIGNERS, concrete and structural, with at least 3 years' experience in heavy reinforced concrete and structural work. Will design heavy reinforced concrete and structural work for heavy steel buildings and structures in process plants and bulk material handling facilities. Salary, about $7,200 a year. Employer will pay the fee. Location, Chicago, Ill. C-5595.

ASSISTANT ENGINEER, B.S.C.E. or M.E., 25–44, interest in office position, design, etc. Knowledge of concrete helpful. Will assist with analysis and design of various types of concrete pipes and specifications, preparation of standards, equipment design, estimating, production planning, engineering aid to distributors, on design, sales, production and drafting. Specialized training will be given. 5 per cent travel. Salary, $9,000 a year. Employer will pay the fee. Location, Chicago, Ill. C-5623.

FIELD ENGINEER, preferably B.S.C.E. or Arch. E., 26–46, with 5 years' construction superintendent experience; will act as field representative, superintendent on erection of buildings and also mechanical and electrical installation. Must be able to relocate and stay in one place from a month to a year. Prefer a man who is single or married with no children. Company will provide car if necessary. Company is paint manufacturer. Salary, $150 a week plus $30 cost of living allowance. Employer will pay the fee. Location, Chicago, Ill. C-5625.

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New Publications

Air pollution control . . . Better understanding of the smog that chokes many American cities may result from a recent ASME booklet, entitled, "Instruments for the Study of Atmospheric Pollution." The publication—said to be the most complete of its kind ever assembled—lists hundreds of devices useful in studying pollution, together with the names and addresses of manufacturers who can supply them. Copies are available from the American Society of Mechanical Engineers, 29 West 39th St. New York 18, N. Y., at $2 each.

Highway officials . . . Availability of the 1956 edition of its annual directory of "Highway Officials and Engineers" is announced by the American Road Builders' Association. The handy pocket-size reference includes more than 1,500 names, titles, and addresses of state highway personnel; engineering and administrative personnel of the Bureau of Public Roads and the ARBA; and a tabulation by states of highway funds spent in 1955. Copies, priced at $1.00 each, are on sale by the ARBA, 600 World Center Building, Washington 6, D. C.

Standards . . . Free copies of a new "List of American Standards" are available from the American Standards Association, 70 East 45th St., New York 17, N. Y. The 56-page book indexes 1,600 American standards—about 275 of them in the field of civil engineering and construction.

Aluminum and its alloys . . . Data on aluminum alloys and mill products are presented in easy-to-read tabular form in a comprehensive reference entitled "Alcoa Aluminum Handbook." An up-to-date successor to "Alcoa Aluminum and Its Alloys," the 176-page publication may be obtained from the Aluminum Company of America, 781 Alcoa Building, Pittsburgh 19, Pa. Request should be made on company letterhead.

Wire-reinforced concrete pavements . . . Dollar savings and better performance are cited as basic reasons for the use of a distributed reinforcement, such as welded wire reinforcement, in concrete pavements in Technical Bulletin No. 217 released by the American Road Builders Association. The author is Henry Aaron, chief engineer of the Reinforced Concrete Pavement Division of the Wire Reinforcement Institute, which has purchased a number of the bulletins and will mail copies to interested persons without charge. Request should be made to the Institute, Dept. 217, National Press Building, Washington 4, D. C.

Community development . . . In "The Heritage of Community," Community Service, Inc. (Yellow Springs, Ohio), presents a critique of community living based on a study of societies of the past. The booklet is particularly directed to persons concerned with world cooperation, underdeveloped nations, and conservation of the earth's resources. It is edited by Arthur E. Morgan, Hon. M. ASCE, president of Community Service, and Griscom Morgan. Copies sell for $1.00 each or for $7.00 in lots of ten.

Lumber selection . . . Selection of lumber for building houses need not be a hit-or-miss matter, according to the Small Home Council, which has issued an eight-page circular giving the essential facts about lumber and its use in home building. Entitled "Selecting Lumber," the booklet may be purchased from the Small Homes Council, University of Illinois, Urbana, Ill., at 10 cents a copy.

Highway research . . . Cooperative studies of highway bridge floors, conducted at the University of Illinois from 1936 to 1954 and described by N. M. Newmark and C. P. Siess, Members of ASCE, have been reprinted from the Proceedings of the 35th annual meeting of the Highway Research Board. Identified as Bulletin No. 52 of the Engineering Experiment Station, the publication may be purchased from the Station, University of Illinois, Urbana, Ill. The price is 25 cents a copy.

Metropolitan mapping . . . Eight new maps, covering Duluth and Superior, Minn.; Hartford and New Britain, Conn.; Bridgeport, Conn.; Rochester, N. Y.; Cleveland, Ohio; Youngstown, Ohio; Knoxville, Tenn.; and San Diego, Calif., have been made available in the continuing series of topographic maps published by the Geological Survey. The Bridgeport and Knoxville maps are $1.00 each, and the others are $1.50. Copies may be obtained from the Geological Survey Map Distribution Sections, Washington, D. C. (for areas east of the Mississippi), and Denver, Colo. (for Western areas).

Ohio River basin . . . Proceedings of a symposium on the Upper Ohio Basin held at Linesville, Pa., under the joint auspices of the Pymatuning Laboratory of Field Biology; Department of Biological Sciences; the College; and the Department of Public Health Practice, Graduate School of Public Health, University of Pittsburgh, have been issued as Special Publication No. 1 of the Pymatuning Laboratory. Entitled "Man and the Waters of the Upper Ohio Basin," the 100-page publication may be obtained from Dr. C. A. Tryon, Director of Pymatuning Laboratory of Field Biology, University of Pittsburgh, Pittsburgh 13, Pa. The price is $1.00 a copy.

Sedimentation bibliography . . . All known hydrologic and sedimentation literature published in the United States and Canada in the 1950–1954 period is included in Joint Hydrology-Sedimentation Bulletin No. 7, compiled and edited by the American Geophysical Union for the Subcommittees on Hydrology and Sedimentation of the Interagency Committee on Water Resources, Department of the Army. Copies are on sale through the Superintendent of Documents, Washington 25, D. C., for $1.25 each.

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For position of Township Engineer in a Morris County, New Jersey, community. Salary open. Applicant must have a New Jersey Professional Engineer's License. Desirable living and working conditions. Experienced individual would have full charge of Township engineering projects, esp. roads, drainage, maps, etc. Reply in detail giving age, experience, salary desired, etc.

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Pictured above is the full-scale cabin mock-up of the Boeing 707, America's *first* jet transport. In developing this interior, Boeing engineers helped design features as advanced as the 600-mile-an-hour performance of the aircraft itself.

Pioneering revolutionary new types of aircraft like the 707 is one of the sources of excitement — and satisfaction — that civil engineers enjoy at Boeing. For the 707 cabin, "C.E.'s" made many major contributions including work on the structural components of seats, windows, baggage racks and over-all body design. Commercial orders for the 707, along with a tremendous backlog of military contracts, assure Boeing expansion for years ahead.

Growth is a Boeing habit. During the past 10 years, for instance, the number of Boeing engineers has increased 400%. Expansion at this rate spells job stability — and plenty of opportunity to move ahead. Boeing promotes from within, and holds merit reviews every six months to give each engineer a *personal* opportunity for recognition, advancement and increased income.

Boeing engineers don't get lost in the crowd. They work in small integrated teams — on such projects, in addition to the 707, as the B-52 and B-47 jet bombers, the BOMARC IM-99 guided missile, the 502 gas turbine, and other developments still under security wraps.

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San Diego Regional Water Pollution Control Board. Opportunity for qualified candidates for the position of Executive Officer in Water Pollution Control Administration. Salary range $8,940 to $10,560 per annum. Applicant must be graduate of a recognized engineering school, preferably with major in sanitary engineering, and have five years of responsible experience and administrative and supervisory experience in water quality control and closely related fields. California engineer registration preferred. Applications may be obtained and filed at the San Diego Regional Water Pollution Control Board, 3441 University Avenue, San Diego 4, Calif.

Maricopa County, Phoenix, Arizona. The Maricopa County Personnel Department is seeking qualified applicants for the position of Civil Engineer II. Salary range from $460 to $575 per month. Requirements are graduation from a four-year college in the field of civil engineering plus considerable experience in civil engineering practice—some of it supervisory. Applicants will be judged on the basis of their training and experience plus an oral interview. Apply to Wilbur L. Jenkins, Personnel Director, Maricopa County, Office of Personnel Director, Phoenix, Ariz.

Bureau of Reclamation. Openings for Engineers in the Western States and in Alaska in Grades GS-5 through GS-9, with salaries ranging from $4,480 to $6,115 a year. Appropriate education and experience are required. Full information and application forms from any post office or from the U. S. Civil Service Commission, Washington 25, D. C., by asking for Examination Announcement No. 10-1-6(56).

County of San Diego. Opening in the Surveyor's office for Assistant Civil Engineer who will be the County Surveyor's representative on the San Diego Metropolitan Area Advance Transportation Planning Team and will coordinate plans with the cities of the metropolitan area. Salary $483 to $587 monthly. Must be a graduate of recognized college or university with a major in civil engineering. Progressive engineering experience may be substituted for college education on a year-for-year basis. Written examination required. Applications should be sent to the Department of Civil Service and Personnel, Clayton G. Swanson, Director, Room 402, Civil Center, County of San Diego.

City of Pasadena. The City of Pasadena offers unlimited opportunities to young engineers interested in a public works career. Future retirements will open opportunities, with wages and benefits equal to the best. Applications should be made to the Personnel Department, City Hall, Pasadena, Calif.

U. S. Bureau of Public Roads. Openings for a highway engineer and bridge engineer, grades GS-7 to GS-13, salary $5,335 to $8,990 a year, for duty in Washington, D. C., and throughout the United States. To qualify, applicants must have appropriate education and experience. Applications will be accepted by the Board of U. S. Civil Service Examiners, Bureau of Public Roads, Washington 25, D. C.

Army Corps of Engineers. The Pittsburgh District has openings for engineers on river, harbor and flood control programs, and vital military defense installations and facilities. Engineers GS-9 (salary range $5,440 to $6,250) and Engineer GS-11 (salary range $6,390 to $7,465). Applications will also be accepted for these positions at the GS-5 and GS-7 grade levels for examination by the Third U. S. Civil Service Region, Customhouse, Second and Chestnut Streets, Philadelphia.

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John Donald Beck, Pittsburgh, Pa.
Jacob Joseph Berger, Harrisburg, Pa.
William Thomas Black, Omaha, Nebr.
Gilbert Brooks, Arlington, Va.
William Hewitt Bush, Washington, D. C.
Ralph De Simone, New York, N. Y.
Joe Dust, Beaumont, Tex.
Edwin Mouzon Eads, San Francisco, Calif.
Ingmar Stellan Gullstrom, Stockholm, Sweden
Lloyd Thomas Hagerty, Dayton, Ohio.
John James Heany, Philadelphia, Pa.
John William Herfurth, Dallas, Tex.
Clifton Walter Higham, East Providence, R. I.
Arthur Milton Jacoby, Atlanta, Ga.
Oscar Victor Emanuel Jansa, Stockholm, Sweden
Esa Michael Khoury, Canoga Park, Calif.
Arthur August Gerhart Kirchhoff, Fort Belvoir, Va.
Peter Charles Malkowski, Salem, Mass.
Anthony Francis Pessolano, Balboa, Canal Zone.
Harry Pockras, Huntington, W. Va.
Alfred George Rayner, Baton Rouge, La.
Francis Hayden Richardson, Indianapolis, Ind.
James Henry Sawyer, Jr., Oelwein, Iowa.
Wallis Isham Schutt, Jackson, Miss.
Kenneth Olen Talley, Kansas City, Mo.
Lawrence Emerson Tull, Alexandria, Va.
Addison Frankland Wilbur, Massena, N. Y.

Applying for Associate Member

Iqbal Ali, Hyderbad, India.
Frederick Henry Bauer, Philadelphia, Pa.
Arnold Mease Blacket, Kansas City, Mo.
Lloyd Edward Brace, Omaha, Nebr.
Alton Alfred Burton, New York, N. Y.
Philip Yeong-Wai Chow, Singapore, China.
Charles Warren Christensen, San Diego, Calif.
Bernard Joseph DeGeorge, Houston, Tex.
Modesto Cruz Diaz, Manila, Philippines.
Peter Brian Dyson, Orange, N. J.
Goodman Basil Espy, Jr., Jackson, Ala.
Yeshayahu Etkin, New York, N. Y.
John Cecil Faber, Hongkong, China.
Vaddakke Kunampillil Gopinathan, Rangoon, Burma.
Mya Han, Rangoon, Burma.
Harry Harvey Hill, Jr., Norman, Okla.
John Reed Hursh, Baltimore, Md.
Leonard Edwin Johnson, Jr., Huntington Woods, Mich.
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Sultan Zahur Akhiar Kiani, Lahore, Pakistan.
Verlyn Dean Kleman, Harrisburg, Pa.
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Wheeler Harold Rucker, Jr., Seattle, Wash.
Fred William Sergeant, Feeding Hills, Mass.
Edgar Wayne Tennis, Springfield, Pa.
Jira Payne Thayer, Los Angeles, Calif.
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Henry William Wallace, Detroit, Mich.
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Samuel Thomas Wilson, Pittsburgh, Pa.
Donald Byron Woltersdorf, Billings, Mont.

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Ralph Edward Crysler, London, Ont., Canada.
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Walter Emery Foster, Kansas City, Mo.
Gunnar John Jakobson, Montreal, Canada.
Peter Vito Laquidara, San Francisco, Calif.
Anthony Lawrence Lutz, Cheyenne, Wyo.
John Edward McLean, Anchorage, Alaska.
Norman Donald Perkins, New Orleans, La.
Willard Eugene Pirtle, Port Arthur, Tex.
William Seppi Powell, Chicago, Ill.
Ernest Everett Schultz, Tampa, Fla.
Donald Charles Sheffield, Albany, Ga.
Peter McKinney Smith, Bonneville, Ore.
Ralph Edwin Spencer, Washington, D. C.
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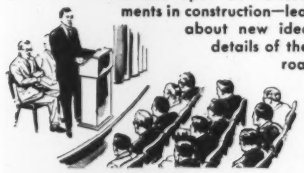

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EQUIPMENT, MATERIALS and METHODS

NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS

All-Wheel Drive Truck

A NEW HEAVY-DUTY ALL-WHEEL drive truck series, engineered and built especially for gravel hauling and highway maintenance, is now available.

The photograph shows one of the all-wheel drive trucks in this new series—Model 45-55JT. These trucks are an adaptation of the Oshkosh 50-50 ready-mixed concrete carrier with the engine cantilevered over the front axle.

Designed for year round use, they are powered by either a Continental 427 cu in. gasoline engine or a Cummins JT-600 diesel engine: have an $8\frac{1}{2}$-cu yd gravel dump body; carry a payload of 18,000 lbs. on the front axle to conform with maximum load limits in most states and built for mounting an underbody blade for road grading work, or a large sander body in conjunction with the underbody blade for winter road maintenance and ice control. A short wheelbase of 144 in. and Vickers power steering assures exceptional maneuverability for spotting loads and handling ease in traffic. **Oshkosh Motor Truck, Inc., CE 11-140, Oshkosh, Wis.**

Model 45-55 JT

Time Switches

THE ADDITION OF SEVEN new time switches to their Intermatic line has recently been announced. The new models offer more accuracy and versatility in control of electrical circuits from periods of 2 seconds to 24 hours. Among these new Intermatic models are the T960 Series, for 1 to 96 on-off operations every day and suited for control of pumps, fans, recorded music, process timings, etc., and the V21000 Series, a seven-day times switch, used for controlling heating and air conditioning systems, lights, fans, etc., on a weekly schedule to permit different timing periods daily, if desired. Another Series, the V22000, is a two-circuit switch that finds wide use in apartment houses, stores, factories, and public buildings. A highly accurate time switch for controlling operations of 5 or 15 minute intervals during a 24-hour period is the V27000 Series. Program timers are among the new models, the V28000 or V29000 Series control 1 to 288 daily operations of bells, buzzers, and signal lights for periods of 2 to 60 seconds. Also included, is the C8300 Series, a twelve-minute cycle repeater timer that can be used on fans, poultry foggers, and similar operations.

Most of these new models incorporate the features of the standard Intermatic line including: easy to set dial, and trippers, heavy duty industrial type motor, and convenient knockouts. **International Register Co., CE 11-140, 2624 West Washington Blvd., Chicago 12, Ill.**

Safety Treads

A COMPLETELY NEW LINE of aluminum safety treads is being introduced. This new tread, trade-named Super-Grit, features an improved design for better appearance, longer life and more safety.

All abrasive metal safety treads depend primarily upon diamond-hard grains of aluminum oxide for their anti-slip qualities. New Super-Grit Treads contain 65% more abrasive grains than any other tread on the market according to the manufacturer.

They come in two widths, 3 inches and 4 inches, and three nosing styles, nosing depths ranging from $\frac{1}{4}$ inch to $1\frac{3}{4}$ inches and may also be curved and mitered in lengths up to 12 feet.

Besides improved design, another feature is the Time-Saver anchors. These anchors are made of the same non-corrosive heat-treated aluminum as the base of the treads and the rivets which hold anchors to treads. Easily bent down a 45 degree angle, they are ready for immediate installation, eliminating 90% of the time spent in attaching conventional anchors. **Wooster Products Inc., CE 11-140, Wooster, Ohio.**

Cement Finishing Machine

A MEDIUM SIZE FOUR BLADE cement finishing machine with crank adjustment to switch blade pitch while the unit is in operation, is designed for use by smaller contractors.

The new model, called the Superior Junior, is built along the same lines as the Superior Senior, a bigger, more powerful, 6.2 hp machine designed for heavy applications. It is powered by a 2.5 hp Briggs & Stratton gasoline engine and has a blade sweep diameter of 33-in.

Because the unit has four variable pitch blades, it does not adapt itself to uneven surfaces and thus works down high spots, giving a truer level finish faster. The finisher handles concrete floating and troweling in one non-stop operation. A crank adjustment on the handle is used to change blade pitch-up to 30 deg tilt of the dual purpose blades for polishing.

Other features include a sealed and lifetime lubricated gear box, Timken main bearings, stationary guard ring for safety and to permit close to wall operation, cast steel tangential arm braces and a mercury safety switch to prevent runaway. **Superior Cement Tool Corp., CE 11-140, 11616 Wright Road, Lynwood, Calif.**

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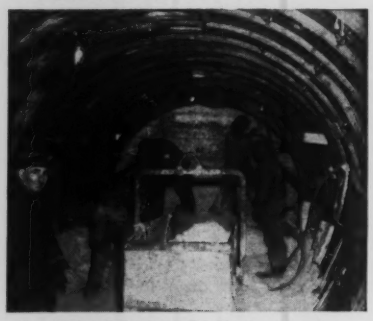

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EQUIPMENT, MATERIALS and METHODS

(continued)

"Magi-Key" Sheave

DESIGNED FOR LOW HORSEPOWER applications, the "Magi-Key" sheave provides for increased maximum design horsepower. In the new sheave, keys transmit all rotational torque, i.e., from shaft to hub and hub to discs. Set screws no longer bite into threads. The flexibly joined set screw and key give a positive lock between the movable discs and stationary hub. Because the key and set screw always remain joined and in place, they cannot drop out during adjustment nor can they move out of alignment. **Allis-Chalmers Mfg. Co., CE-11-142, 1187 S. 70th St., Milwaukee, Wis.**

Transverter

THE NEW CLARK "TRANSVERTER," a power train package consisting of a torque converter, hydraulic disconnect clutch and standard transmission, is now standard equipment on the Series 100 Clark-Ross straddle carriers and available optionally on the Series 93 carriers.

Designed specifically for off-highway and stop-go operations, the unit was introduced in July by Clark's Transmission Division. Its operational advantages include elimination of engine stalling and lugging, sharp reduction in gear shifting to the point where most work can be performed in the same gear, and fine inching control by simply working the throttle. **Clark Equipment Co., CE 11-142, Battle Creek, Michigan.**

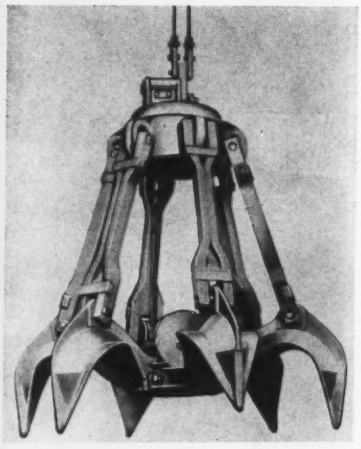
Model 90-M Pump

A NEW 6-IN. CONTRACTOR'S PUMP has been announced. The most remarkable feature of this pump is its increased performance and decreased size and weight. The reason for the unit's superior performance is its big capacity design which utilizes lower engine speeds to do more work, thereby saving wear and tear and greatly increasing pump life. It features dual volute priming action which assures fully automatic priming. A top entrance suction connection is provided for dependability and water ways of the pump will easily pass a 2-in. solid sphere. The machine is powered by the radiator cooled 244-cu in. Continental engine, which develops a constant 55 hp at 1800 rpm. Safety controls automatically shut off the unit in case of high engine temperature or low oil pressure. It is available with either skids, steel wheels, or 550 × 16-in. pneumatic-tired wheels. **Pump Division, Construction Machinery Co., CE 11-142, Waterloo, Iowa.**

Grapple

REPRESENTING AMERICA'S FASTEST GROWING line of "grab-dig" tools, the Model M-1 Grapple has five, six or eight tines, depending on the size of the grapple. Each tine is independent of each other and is positively activated, like fingers of a giant hand, to wriggle and dig deep into object or material. Final resistance is met with a grip of up to 50 tons—five times the weight of the grapple.

Features of the new M-1 include: vertical slideways with "barrel-type" bushings for maximum vertical and angular tine movement; one piece top head with spun,



Model M-1

flanged and dished head for rigidity and great strength; welded, rigid arms for resistance to impact and long life; rocking sheave blocks at top and bottom of grapple for bigger loads at any digging angle . . . reduced wire rope wear; hardfaced points for greatest resistance to abrasive wear. Wear plates of manganese steel are available for heavy model grapples.

These features enable the grapple to handle heavy boulders, beams, irregular shaped objects and dig in packed or loose materials with equal efficiency. Available in sizes from .33 to 3.3 cu. yd. **Ruhr Industries, CE 11-142, 1411 Walnut St., Philadelphia 2, Pa.**

Koh-Liner

A new device is offered that enables anyone to draw evenly distanced parallel lines, precisely spaced crosshatching and shading quickly and without effort. The accuracy of the Koh-Liner is obtained through the use of a push-button increment advance mechanism. You set the dial for the line spacing desired and push the button, drawing the lines along the advancing straight edge. **Koh-I-Noor Pencil Co., CE 11-142, Bloomsbury, N. J.**

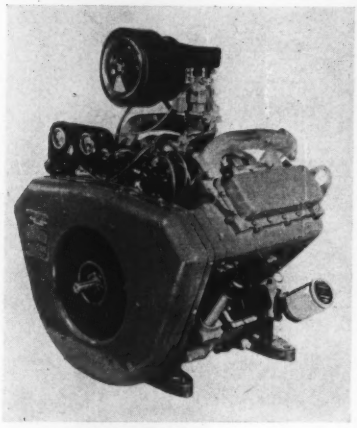
EQUIPMENT MATERIALS and METHODS

(continued)

New Air-Cooled Engine

A NEW VALVE-IN-HEAD, compact four cylinder vee type engine designed for all general applications in the industrial, agricultural and construction fields has been announced. Designated as the model CV4-180, the engine delivers 70 horsepower at 3000 rpm. It is the first air cooled engine to meet this industrial field challenge.

Its ruggedness and smooth operating performance have been demonstrated both in the field and through laboratory and dynamometer testing. The new four-cylinder engine features the proven design and interchangeability of major component parts with its counterpart, the C2-90 model 30 horsepower engine, such as the

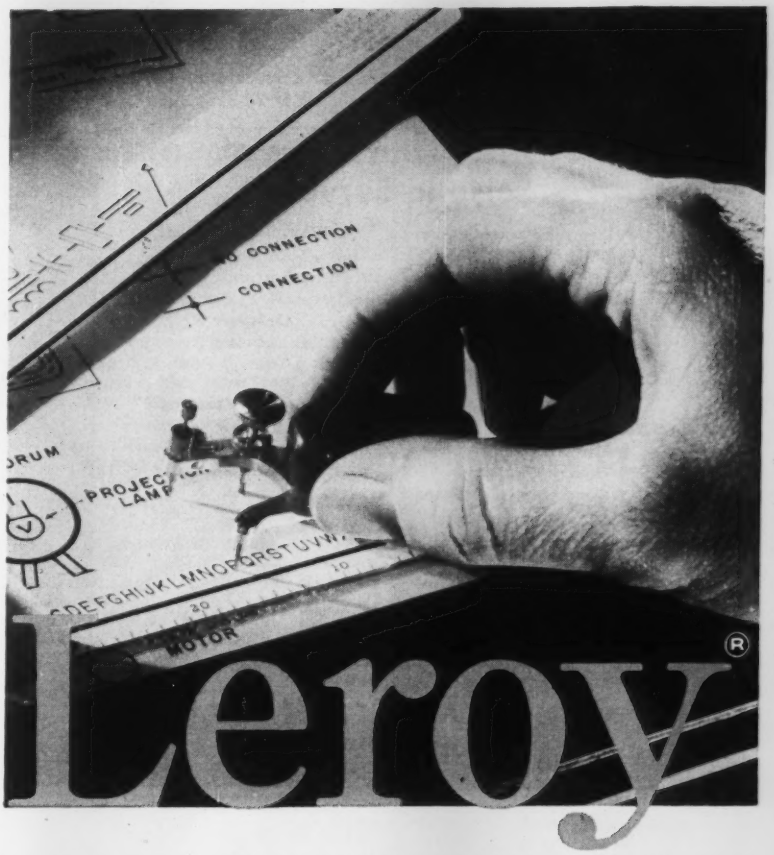


CV4-180

aluminum cylinder head of valve-in-head design, cylinder barrels, pistons, forged connecting rods, bearings, valves, etc. A full pressure lubricating system is employed.

A four throw, three main bearing dynamically counterbalanced crankshaft and twin three bearing camshafts are included in the engine design. All engine accessories are flange mounted and gear driven from the timing gear train housing.

The CV4-180 weighs approximately 463 pounds less electric starter, generator and flywheel housing which are being offered as optional equipment. The engine power end will be offered with SAE #3, 4 and 5 bell housings as with special pump adaptors and shaft extensions to suit customer requirements. Simplified engine design assures easy installation and servicing. **Lycoming Division, AVCO Mfg. Corp., CE 11-143, 550 S. Main St., Stratford, Conn.**



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- Water supply....Water Resources Auth., Puerto Rico
- Dam site.....Dover, New Jersey
- Hurricane Barrier.....Narragansett Bay, R. I.
- Quarry exploration.....Massachusetts
- Generating plant expansion site..Staten Isl., N. Y.
- Housing development site.....Trumbull, Conn.

For a copy of our factual Bulletion 2 on seismic surveys, write to Geophysical Survey Division, Gahagan Dredging Corp., 90 Broad St., New York 4, N. Y.

Established in 1898, Gahagan is a leader in hydraulic dredging

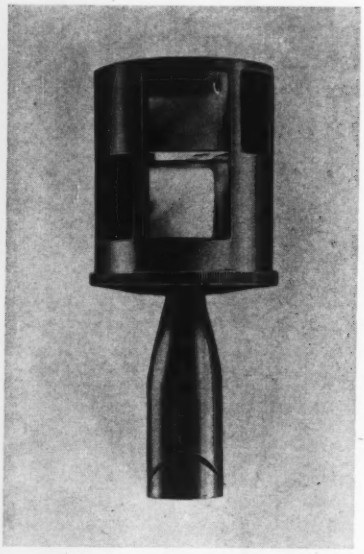
ANOTHER
GAHAGAN
CASE HISTORY

EQUIPMENT MATERIALS and METHODS

(continued)

Prism Device

ELIMINATION OF ONE MAN from a property surveying party can be effected through the use of a double pentagonal prism, an instrument which utilizes a set of two prisms. This double pentagonal prism can be used to measure all 90 and 180-deg angles on property survey. The instrument is about the size of a plumb-bob but considerably lighter and is a combination of two prisms having four windows, two in front (one upper and one lower), one on the right side, and one on the left. On



the bottom of the instrument, in the exact center, there is a hook to which the string of a plum-bob can be attached.

Another newly developed advantage of the prism is that it is covered as a protection against dust and moisture. **Geo-Optic Company, Inc., CE 11-144, 170 Broadway, New York 38, N. Y.**

New Hardsurfacing Flux

A NEW ADDITION TO ITS line of hardsurfacing agglomerated alloy fluxes has been announced. The flux, H-560, is used with the submerged arc welding process to produce a hardsurfacing deposit using a mild steel electrode. It is an agglomerated mixture of fluxing materials and alloys which will produce a high carbon, high alloy weld deposit when used with Lincoln's L-60 mild steel automatic electrode wire. Alloys are added to the weld

(*Continued on page 145*)

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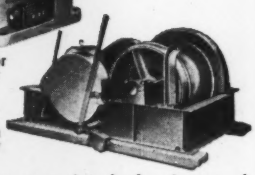

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EQUIPMENT MATERIALS and METHODS

(continued)

deposit through the flux. Agglomeration bonds the flux and alloy particles together, each H-560 particle containing flux and alloy in proper proportion.

It will make a deposit with a hardness of 53 to 61 Rockwell RC that cannot be torch cut or forged. The deposits will resist scaling and flaking and retain a highly polished surface when subjected to metal friction. The hardness and abrasion resistance is unaffected by the cooling rates normally encountered in welding.

H-560 flux is excellent for the fabrication and maintenance of wearing parts where the service involves severe abrasion and medium impact. It will perform successfully under abrasive conditions at temperatures as high as 1100°F. **The Lincoln Electric Company, CE 11-144-145, Cleveland 17, Ohio.**

Brush Cutter

A HIGHLY EFFICIENT ROTARY Brush Cutter is now being produced. Two models are available—the model R, for tractors with 3-point lifts and model RD, for drawbar tractors. Both cutters have a cutting width of 60 inches and the height of the cut is adjustable 1 inch to 12 inches.

Suitable for cutting thin growth, the cutter will also cut any growth the tractor can push over. The flywheel is protected

Available in two models

by a shield which raises the cutter over heavy stumps, rocks and other obstructions thus allowing the flywheel to continue turning until the obstacle is passed over and normal cutting operation is resumed. The cutter needs no shear pin. Two 10 pound serrated blades swing freely.

Contractors find these models ideal for clearing right-of-way and lands of all conditions. **Dorsey Trailers, CE 11-145, Elba, Alabama.**

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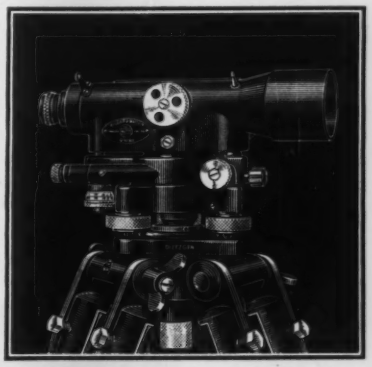

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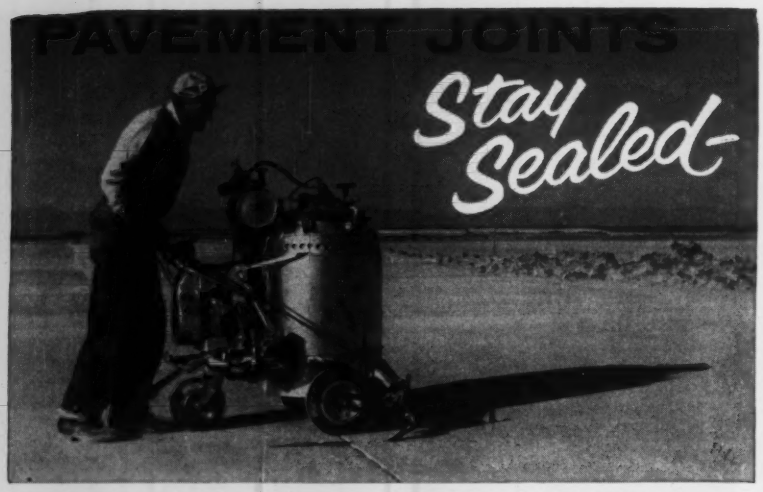

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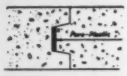

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EQUIPMENT MATERIALS and METHODS

(continued)

Pipe Pusher

THE POW-R MOLE IS A compact new device for pushing in water and gas lines and pulling copper or lead lines up to 3″ in diameter under roads, streets, sidewalks, lawns or wherever it's better not to dig up the surface. It replaces the bucket on any standard tractor-mounted hydraulic backhoe using the 2 bucket mounting pins. One man can dig the trenches, attach the unit, insert the pipe sections and operate the tractor hydraulics. Since it utilizes the power of the tractor to push or pull pipe, and down pressure on the backhoe boom stabilizes the unit while in operation, no other equipment such as air compressors, jack hammers, or winches is needed.

With the Pow-r Mole, if a major obstruction is encountered when pushing pipe, the pipe can be pulled out and pushed in a different spot to avoid the obstruction. Direction is reversed by changing the position of two drag springs with no need to turn the tractor around. **Pow-r Devices, Inc., CE 11-146, Dept. 110, Clarence Center Road, Clarence Center, N. Y.**

Pow-r Mole

TIDE GATES

Fig. B-68, Type M
(CIRCULAR)

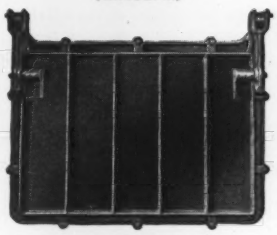

Fig. B-61, Type MM
(RECTANGULAR)

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EQUIPMENT MATERIALS and METHODS

(continued)

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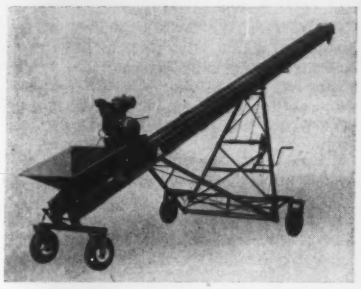
ELEVATIONS TO 20 FT AT 30° are now possible with the complete addition of a 40 foot Concrete Special to the Con-vay-it line of conveyors. Powered by a 9-hp., Wisconsin Gasoline Engine this unit can pour approximately a yard per minute in the horizontal position. A snub pulley has been added to increase belt power by as much as 20%. This pulley is unique in that its design prevents packing of concrete.



40 ft Conveyor Unit

The conveyor unit can be equipped with an elevating device and complete swivel wheel assemblies permitting sidwise movement when pouring wall forms. In addition, front and rear swivel wheel frames have been designed for the complete line to serve the need of horizontal conveying on slab pours.

Three standard lengths of 20 ft, 30 ft and 40 ft are now available to contractors, providing complete flexibility and added combination lengths for tandem use. **American Conveyor Co., CE 11-147, 2133-37 So. Christiana Ave., Chicago, Ill.**

Steel Scaffolding Bracket

A NEW GALVANIZED STEEL scaffolding bracket, recently introduced, is achieving wide acceptance in the construction field. The bracket is a light, compact unit that can be secured to forms with standard form hardware. Completely collapsible to simplify handling and moving, it will accommodate three 2 × 10's for a platform. Handrail bars will support a 2 × 4 at a height of 42″ above the platform. When handrail is not required the support bar may be pivoted down flush with the horizontal member of the bracket. The recommended safe working load is 1,000 pounds per bracket. **Symons Clamp & Mfg. Co., CE 11-147, 4249 Diversey Avenue, Chicago 39, Ill.**

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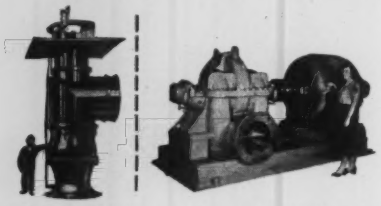

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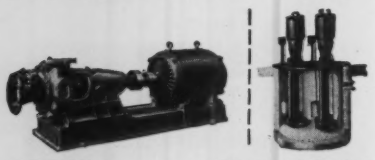

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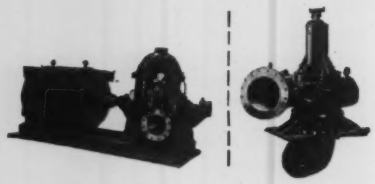

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INDUSTRIAL SIGNALS—The most comprehensive bulletin ever published in the American signal industry on the proper use of modern visual and audible signals for industrial manufacturing plants of all types has been published. It covers the gamut from the history of signalling by man, reviews the basic principles of the physics of sound, and then moves into a thorough analysis by experts on the right signal for the right job in industry. **Federal Sign and Signal Corp., CE 11-148, 8700 South State St., Chicago 19, Ill.**

INDUSTRIAL FLOORING—A 12-page Specification and Installation Manual illustrating the latest methods for prolonging the life of industrial floors with Klemp's exclusive heavy duty steel floor armors, has just been published. This new manual, the result of years of experience and technical background in the grating and floor armor field and written in a concise technical manner by Klemp engineers and technicians, is a specialized report containing several pages of data tables, filler weights, specifications; illustrated installation procedures and various specialized uses of Hexteel and Floorsteel in a number of industries such as the oil and chemical industry, the railroad industry, etc. **Klemp Metal Grating Corporation, CE 11-148, 6615 South Melvina Avenue, Chicago 38, Ill.**

BELT IDLER—A new 12-page, 2-color, Limberoller Belt Idler Booklet 2-59A, now being offered, contains design and application data for those who select, specify, purchase and use belt conveyors to handle bulk materials. Included are descriptions, dimensional drawings, specification tables and suggested applications for Limberoller Idlers and various troughing, impact, training and return brackets to use with belt widths of 18 in. through 72 in. **Joy Manufacturing Company, CE 11-148, 307 Oliver Building, Pittsburgh 22, Pa.**

SHOCK AND VIBRATION CONTROL—A new bulletin, SVC-55, has just been issued on the basic theory of vibration isolation and shock absorption. It describes various types of machinery vibration, gives basic data, formulae and graphs that enable the reader to recognize his own problem, and reviews practical methods of shock vibration and control. **T. R. Finn and Company, Inc., Industrial Division, CE 11-148, 200 Central Avenue, Hawthorne, N. J.**

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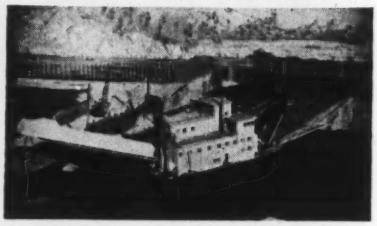

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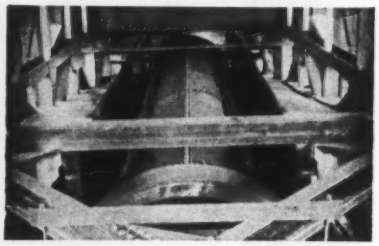

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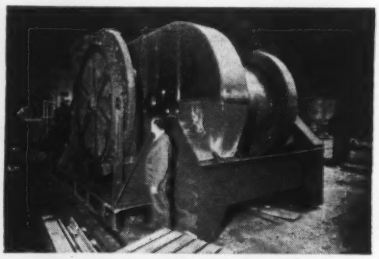

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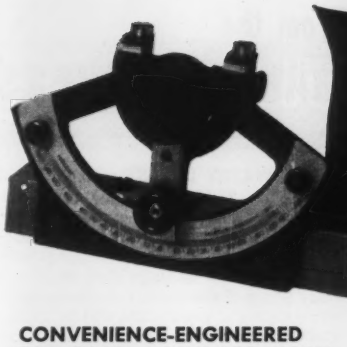
"Arctic Convoy"—A historic film proving that truck trailer convoys are capable of operating in the roadless arctic wastelands will be released for public viewing this fall. It documents a 1200-mi journey by a truck caravan through uncharted arctic wastelands to the DEW line radar network, a feat never before successfully completed by a truck convoy. **Mack Trucks, Inc., CE 11-149, 1355 West Front St., Plainfield, N. J.**

"Roadbuilding with the 'Grid' Roller"—Roadbuilding with the hi-speed Hyster "Grid" roller is shown in a highly informative new 16 mm sound motion picture available for free showing. The color movie was filmed by their engineers on all types of actual road projects—turnpikes, secondary roads, farm to market roads and logging roads. A portion of the movie filmed on the Kansas Turnpike describes the efficient hi-speed compaction performance of the roller when teamed with the Caterpillar DW-15 tractor. Crushing pit-run rock and surfacing logging roads are explained in other scenes. **Hyster Company, CE 11-149, 2902 N. E. Clackamas St., Portland 8, Ore.**

"We're Blasting Near You"—Contractors faced with a public relations problem in the performance of blasting operations in and near populated areas will be interested in a new 25-minute motion picture which is available. The color film describes the precautions that blasters take to prevent accidents and protect private property. Modern methods of controlled blasting which reduce the hazards of ground vibration, concussion and flying rock are emphasized. **Explosives Development Section, Atlas Powder Co., CE 11-149, Wilmington 99, Del.**

"Pipe Insulation"—An 11-min sound slide film about a pipe insulation that saves up to 50% in installation time over conventional insulations has recently been released. Designed originally for residential air-conditioning and dual-temperature lines Armaflex, a new, flexible, foamed plastic pipe covering has been found to be extremely practical in preventing condensation on any residential-commercial copper tubing or iron pipe operating in a temperature range of 32–200 deg. The film shows the method of application. **Armstrong Cork Co., CE 11-149, Insulation Division, Lancaster, Pa.**



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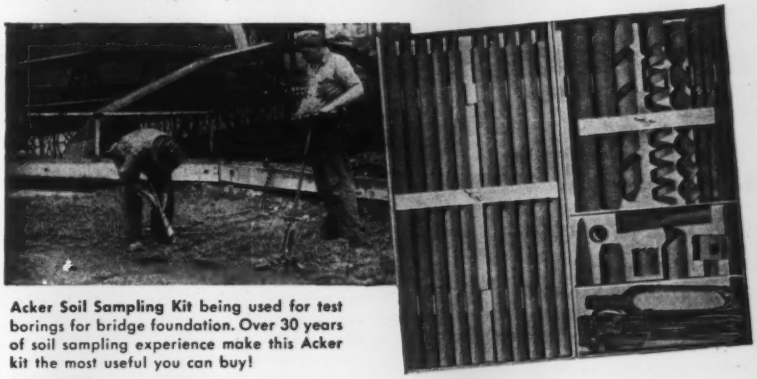

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LARGE WATER INTAKE: Negotiations for a vast $2,500,000 undertaking—installation of a large water intake for Granite City, Ill.—is unique in that Ranney Methods Water Supplies, Inc., has contracted under a package deal to handle every phase of the project, including engineering design, installation and financing. The intake will yield up to 75 million gallon per day... **CONSTRUCTION OSCARS:** The Beavers, an organization of the leading heavy construction companies in the west have selected two men in each of four categories: Management, Engineering, Supervision and Service-Supply. The awards will be made at the Annual Awards Dinner at Los Angeles, January 17, 1957... **RENTAL OF CONSTRUCTION EQUIPMENT:** The acquisition of the multi-million dollar contracting equipment assets of the Anderson Brothers Corp. by Brazos Equipment Rental Co. of Houston, Texas, has been announced. This now makes available for rental the world's largest assembly of contractors' equipment which is comprised of almost any type used for road building, heavy construction, etc.... **AGE OF STEEL:** This year's production of steel includes the three billionth ton made in the U. S. since the "Age of Steel" began to take shape about a century ago. The bessemer process has accounted for about 4½ million tons while the open hearth process which became the leading process about 1908 has about 2½ million tons of this total... **PIPE LININGS:** One of the largest centrifugally spun coal tar lining projects: 100,000 interior sq ft of pipe, in size from 84 to 108 in. in dia and 40 ft in length, each section weighing 31 tons was completed by Pipe Linings, Inc., Wilmington, Calif., for the Tri-Dam Project penstocks in Calif... **44 MILE DELAWARE AQUEDUCT EXTENSION:** This project begins with a tunnel at Cannonsville, N. Y., with an approximate dia of 14 ft. The huge undertaking will employ thousands of workers and will use an astonishing number of tools and equipment. Gardner-Denver Company, Quincy, Ill., one supplier, has initial orders for 4 portable rotary compressors, 6 grout pumps, 45 drifters, 50 stopers and 75 other pieces of equipment... **FEDERAL-AID HIGHWAY PROGRAM:** What this multi-billion dollar federal aid highway program will mean to the public and business and how it must be coordinated with dependable transit systems and adequate parking was outlined by speakers at a Regional Businessmen's Highway, Transit and Parking Conference in Boston, Mass. October 10 and 11. More than 400 businessmen from the New England area and N. Y. state attended... **$3,000,000 IN MECHANICAL WORK:** Contracts have been awarded recently to Charles Simkin & Sons, Inc., Hopelawn, N. J., which include prime contracts in addition to specialized work in heating, ventilating, air conditioning, power and process piping and plumbing...

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September

1066. Discussion of Proceedings Paper 921. (SU) Sumner B. Irish, William A. White on 921.

1067. Discussions of Proceedings Papers 735, 763, 914, 915. (ST) A. S. Veletsos and N. M. Newmark closure to 735. Adrian Pauw closure to 763. A. C. Scordelis, Robert R. Dickey, A. A. Eremin, Jacob Karol on 914. A. A. Eremin, Edward Cohen and Edward Laing on 915.

1068. Discussion of Proceedings Papers 727, 801, 803. (WW) David A. Hopkins closure to 727. Rufus H. Carter, Jr., closure to 801. Walter F. Lawlor closure to 803.

1069. Design Considerations for a New Lock at Wilson Dam, by Robert A. Monroe and George P. Palo. (WW) Navigation of the Tennessee River has increased to such extent that the existing locks at Wilson Dam will soon be inadequate to handle the traffic. This paper discusses the major features of design of a new single-lift lock at Wilson Dam having a lock chamber 110 ft wide by 600 ft long, and with a maximum list of 100 ft.

October

1070. Truss Analysis by Stiffness Considerations, by Harold C. Martin. (EM) A method is developed for conveniently analyzing redundant trusses by using a stiffness matrix. This procedure is routine as illustrated by examples. Numerical operations on the stiffness matrix leads to a solution that can be made by desk calculator. The method can be extended to other structures.

1071. Plastics, by Gordon M. Kline. (EM) The properties and applications of the various commercial plastics are reviewed. Statistics regarding the consumption of plastics in major end uses in 1955 are presented. Work which is now being undertaken on the development of standards for plastics suitable for use in civil engineering is discussed. References to reports on the economic position and engineering uses of plastics are cited.

1072. Plastics: Engineering Materials, by C. H. Adams. (EM) This paper concerns engineering characteristics of plastics and their reaction to environments of force, time and temperature. Subject will be developed through: (1) comparing plastics with older materials; (2) comparisons of plastics by generic groups; (3) quantitative comparisons of plastics with other materials; and (4) analysis of design considerations for plastics.

1073. Minimum-Weight Design of a Portal Frame, by William Prager. (EM) This paper concerns minimum-weight design of frames assuming that the unit weight of a structural member is proportional to the α-th power of its fully plastic moment, the positive exponent α being smaller than unity. For $\alpha = 2/3$, a chart is developed giving minimum-weight design for various geometrics and loading conditions of a portal frame.

1074. Modernizing a Texas Highway with Concrete, by Allan L. Chollar. (HW) This paper outlines design and construction procedures in planning and constructing concrete resurfacing over a 34-yr old, 16-ft concrete pavement. The new 24-ft pavement is part of the 4-lane divided modernization of this highway. Construction details of longitudinal and transverse jointing procedures are described.

1075. Economics of Self-Protection of Highways Against Flood Damage, by J. C. Young. (HW) Flood-protection economics for highways must take into account engineering, legal, and public interest considerations, both tangible and intangible. To reach sound decisions, it is important to know the limitations of economic analysis. This paper gives an appraisal of the factors involved and the logic of their application.

1076. Foreign Operations of the Bureau of Public Roads, by A. C. Taylor. (HW) This paper describes how the Bureau of Public Roads (United States Department of Commerce) is extending highway technical assistance to foreign countries. Arrangements under which this program is carried on and administered and the status of work in several countries, the program's aims, and the difficulties of recruiting personnel are set forth.

1077. Flood Protection of Canals by Lateral Spillways, by H. Tults. (HY) Water-level profiles in front of lateral spillway crests can be computed by Bernouilli and continuity equations. Nonuniform velocity distribution is taken in account. Examples demonstrate the limitations of application of lateral spillways and possibilities of improving discharge capacities by enlarging cross sections and placing additional orifices behind spillways.

1078. SED Research Report No. 8: On Treatment of Alkaline Sulfur Dye Waste with Flue Gas, by The Sanitary Engineering Research Committee, Industrial Wastes Section. (SA) The authors describe the results obtained when treating alkaline sulfur-containing dye wastes in a jet-flue pilot plant.

1079. Pile Tests, Low-Sill Structure, Old River, La., by C. I. Mansur and R. I. Kaufman. (SM) Pipe and H-beam piles founded in sand underlying 50 ft of silt were tested in tension and compression. Distribution of load along the pile and at the tip was determined from strain rods. Skin friction in silt and sand and tip-bearing capacity in sand were also determined.

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1080. Foundation Studies for Delong Piers, by W. G. Shockley and T. B. Goode. (SM) Results of experimental investigations of the bearing capacity of 6-ft-diameter pier barge spuds in three types of foundation soil are presented. Bearing capacities computed from existing formulas for large cylindrical piers and results of field penetration tests are correlated with measured bearing capacities of the spuds.

1081. Soil Modulus for Laterally Loaded Piles, by Bramlette McClelland and John A. Focht, Jr. (SM) Using results from a lateral-load test on a 24-in. pipe pile and laboratory tests on undisturbed clay samples, a tentative procedure is developed for estimating the soil modulus of pipe reaction in problems involving transient loads. The correlation derived is based on the similitude on logarithmic paper of laboratory stress-strain curves and soil-deflection curves from the pile test.

1082. The Problem of Reservoir Capacity for Long-Term Storage, by A. Fathy and Aly S. Shukry. (HY) In this paper a method is suggested for the systematic analysis of hydrological observations in order to obtain a full representation of the capacity-yield relation for long-term storage in any given case. The cost-yield relation could readily be determined and the choice of capacity could be made in full view of all physical and economic factors involved.

1083. Sedimentation Studies, by D. E. Bloodgood, W. J. Boegly, and C. E. Smith. (SA) Sedimentation studies were carried out in the laboratory to substantiate Hazen's theory that sediment removal is dependent on surface area and independent of depth. Results showed removal of sediment was dependent on the force of the incoming water.

1084. An Improved Dilution Method for Flow Measurement, by W. A. Cawley and J. W. Woods. (SA) A procedure is outlined for measuring flow in sewers containing industrial wastes by a manganese dilution method. An inexpensive technical grade of manganous sulphate was injected into the sewers and the degree of dilution determined quantitatively by flame spectrophotometric analysis. It is felt that this approach provides an accurate and relatively simple method for use with industrial wastes.

1085. Municipal Ordinances for Industrial Wastes, by Julian R. Fleming. (SA) The problem of municipal ordinances for handling industrial wastes in municipal sewerage systems and sewage treatment plants is discussed from experiences at Knoxville, Tenn.

1086. Hydro-Electric Power in the Southeast, by C. P. Lindner and L. F. Johnson. (PO) This paper reviews the history of hydroelectric development in the southeast. Contrary to widespread impression, many potential sites still remain undeveloped which can become economical by constructing multipurpose projects in which each element contributes a fair share of its cost.

1087. SED Research Report No. 9: Evaluation of Water Resources of a River Basin, by The Sanitary Engineering Research Committee, Water Section. (SA) A rational method of evaluating the water resources of a river basin is developed and applied to the Neuse River Basin in North Carolina.

1088. New Developments in Septic Tank Systems, by John E. Kiker, Jr. (SA) During the past few years there have been some important changes in the design criteria for septic tanks and subsurface sewage disposal systems. These changes are set forth and evaluated.

1089. Preliminary Studies on Complete Anaerobic Sewage Treatment, by J. B. Coulter, S. Soneda, and M. B. Ettinger. (SA) Laboratory studies are described for the development of anaerobic contact sewage treatment system for use in small subdivisions which produces an effluent low in B.O.D. and suspended solids.

1090. The Highway Spiral as a Centerline for Structures, by Paul Hartman. (HW) This paper presents a method for computing the geometry of a structure with a spiral centerline. The method is simple and precise enough for steel work. The amount of computation is no greater than that required for the multicentered curve which customarily replaces a spiral on a structure.

1091. Discussions of Proceedings Papers 817, 818, 945, 1030. (EM) Chong-Hung Zee, Dean F. Peterson, and Robert O. Bock closure to 817. Daniel Frederick closure to 818. E. Silberman, N. N. Ambraseys on 945. G. W. Housner on 1030.

1092. Discussions of Proceedings Papers 714, 745, 747, 840, 953, 1006. (HY) J. J. Dronkers and J. C. Schonfeld closure to 714. E. W. Lane closure to 745. M. B. McPherson and H. S. Strausser closure to 747. Herbert M. Corn closure to 840. Arthur I. McCutchan, Sam Shulits on 953. Achille Lazard on 1006.

1093. Discussions of Proceedings Papers 703, 783. (HW) Corrections to 703. C. J. Posey closure to 783.

1094. Discussions of Proceedings Papers 696, 742, 959. (PO) M. Rocha, J. Laginha Serafim, A. F. da Silveira, and J. M. Ressurreição Neto closure to 696. T. C. Powers closure to 742. Ross M. Riegel on 742. G. S. Sarkaria, George E. Goodall on 959.

1095. Discussions of Proceedings Papers 757, 862, 866, 934, 940, 941, 1026. (SM) Horace A. Johnson closure to 757. C. Y. Li closure to 862. E. de Beer and A. Martens on 866. G. A. Leonards, John A. Focht, Jr., E. J. Zegarra, K. B. Hirashima on 934. L. A. Palmer, David A. Hopkins on 940. John V. Spielman, Nicols N. Ambraseys on 941. A. A. Eremin on 1028.

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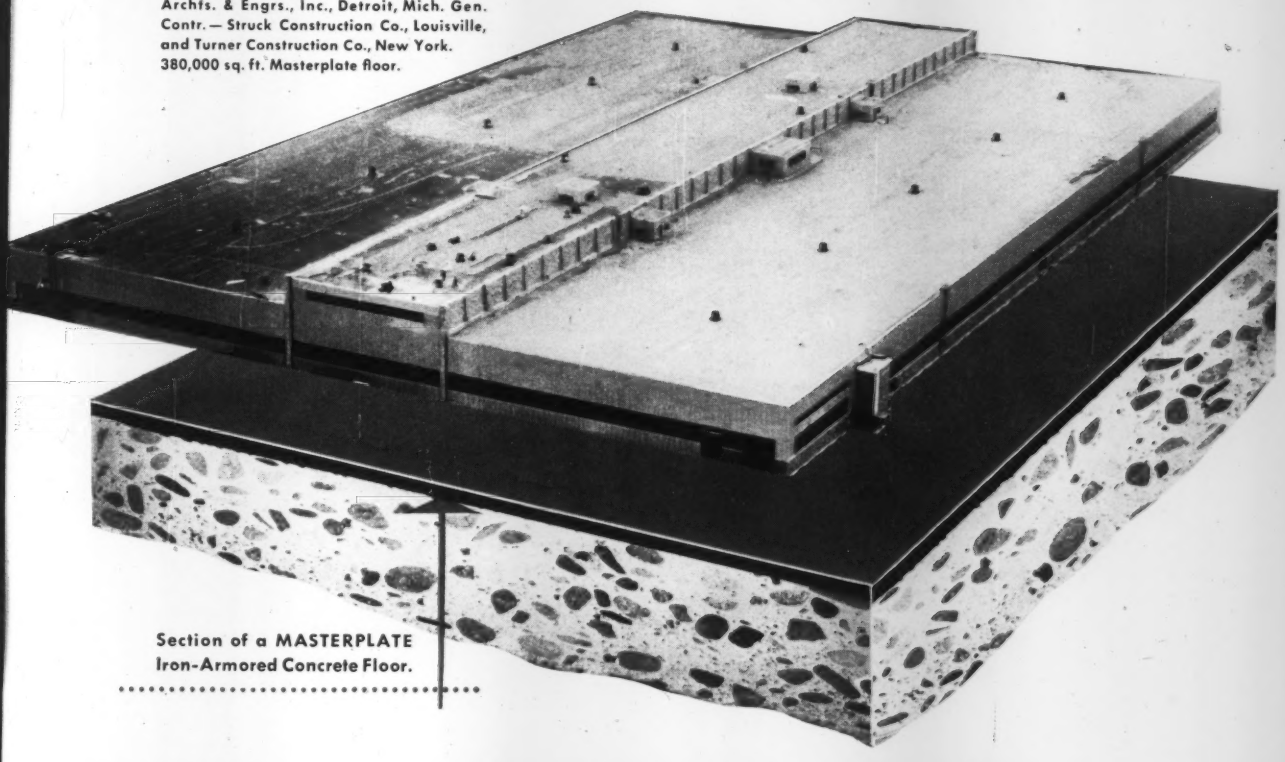

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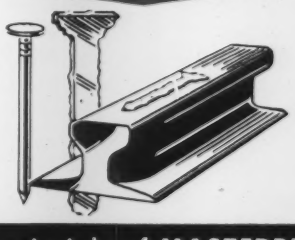

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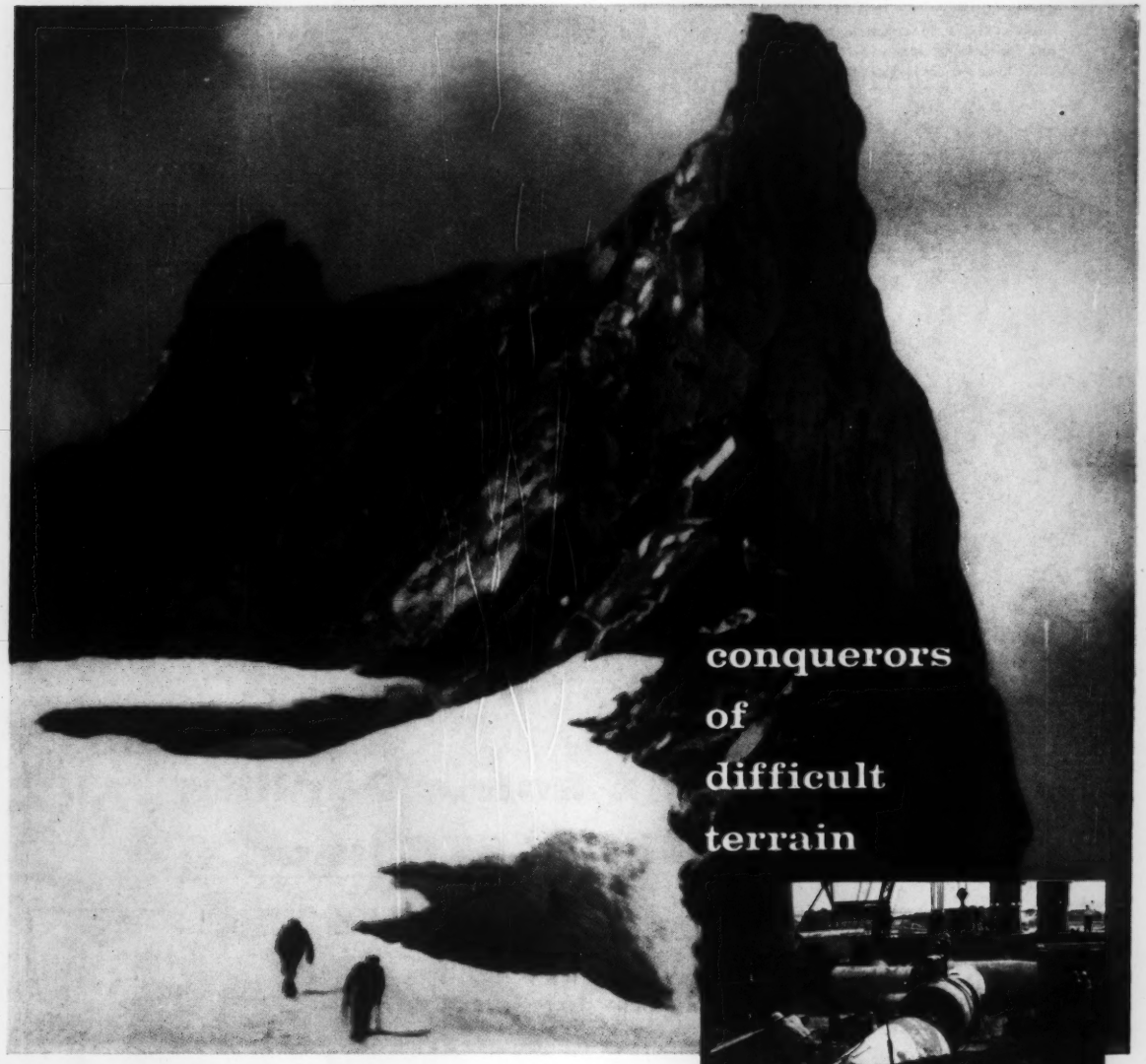

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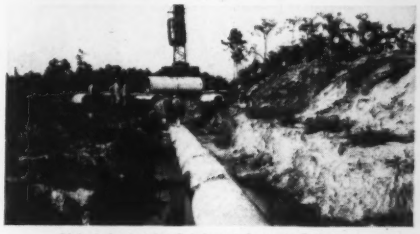

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